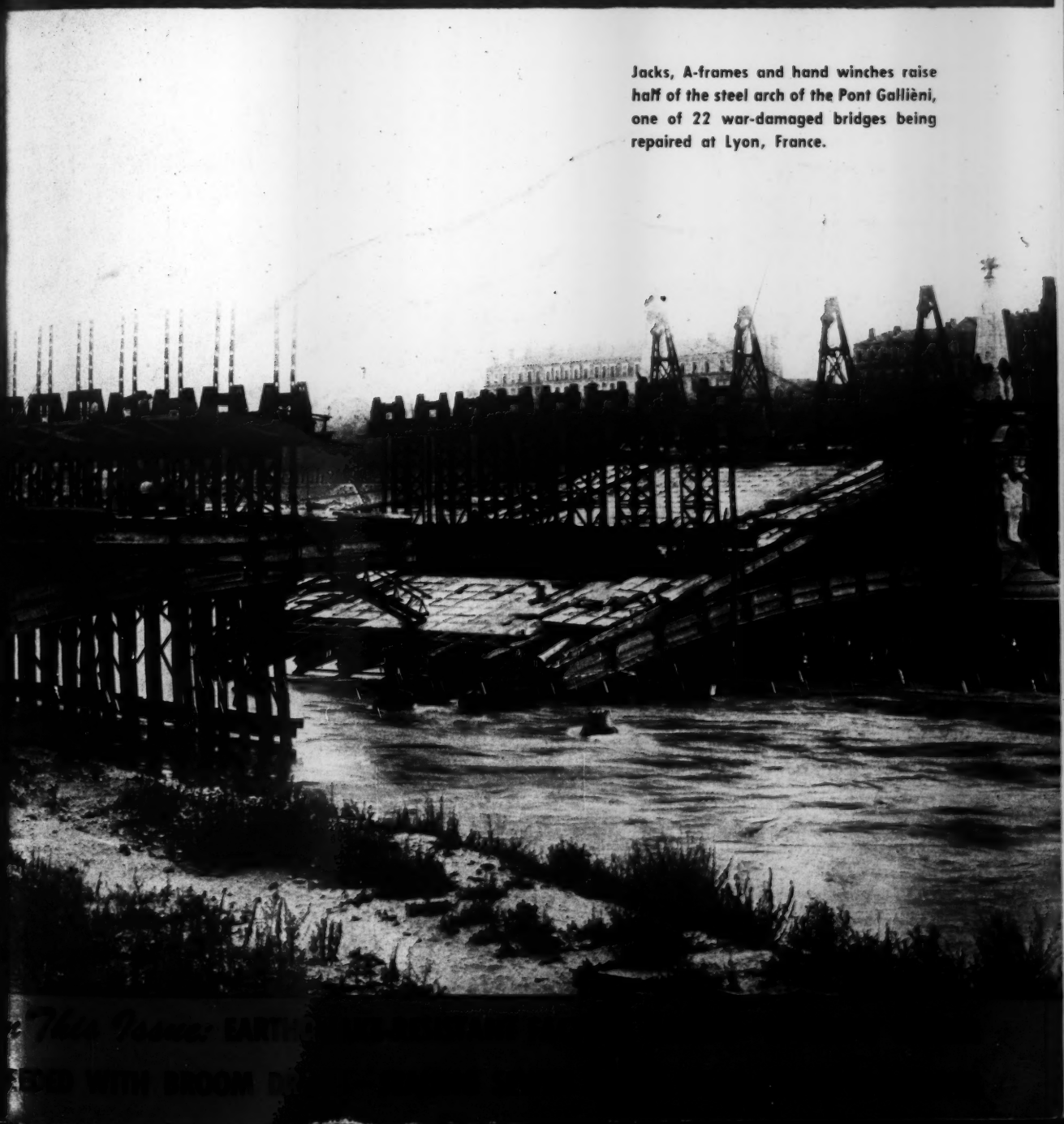
ENGINEERING NEWS-RECORD

JANUARY 9, 1947



Jacks, A-frames and hand winches raise half of the steel arch of the Pont Gallièni, one of 22 war-damaged bridges being repaired at Lyon, France.

Road building used to be a first-class headache

Old time road builders did their best but Mother Nature generally beat them at every turn. Then *Engineered Drainage* turned the tide and now you can build first-class roads without the headaches.

But it didn't just happen. Road builders recognized the problems and Armco Engineers cooperated with them. More than 40 years ago they began to develop drainage and other products to meet specific highway and construction needs — perforated pipe to drain subsurface water; MULTI PLATE and corrugated pipe for surface drainage, and many more. Armco Engineers whipped erosion and corrosion; speeded up installation; provided greater safety and economy at every turn.

The helpful, authoritative information that came out of these years of experience is obtainable from no other source. Here among the cumulative data of thousands of installations, as well as field and laboratory tests, may be the answer to your problems.

These are some of the reasons why you'll be time and money ahead by bringing your drainage and construction problems to Armco. From this single, convenient source you can obtain a complete range of engineered products and all the help you want in applying these products to your designs. Usually there are case histories of similar problems in every field — highway, railway, airport, municipal or industry. If it is something new, you'll want to talk it over with one of our specialized Armco Engineers.

Structural Plate Pipe & Arches ★ Corrugated Metal Pipe ★ Welded Steel Pipe ★ FLEX-BEAM Guardrail ★ Water Control Gates ★ Retaining Walls ★ STEELOX Buildings ★ Sheeting ★ Tunnel Liner ★ Subdrainage Pipe ★ End Sections ★ Pipe Piling ★ Pile Shells ★

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ENGINEERING NEWS-RECORD

Devoted to Buildings, Sewerage, Waterworks, Bridges, Roads, Dams, Foundations, Earthwork, Flood Control, Public Works, Airports, Irrigation, Canals, Tunnels, Railroads

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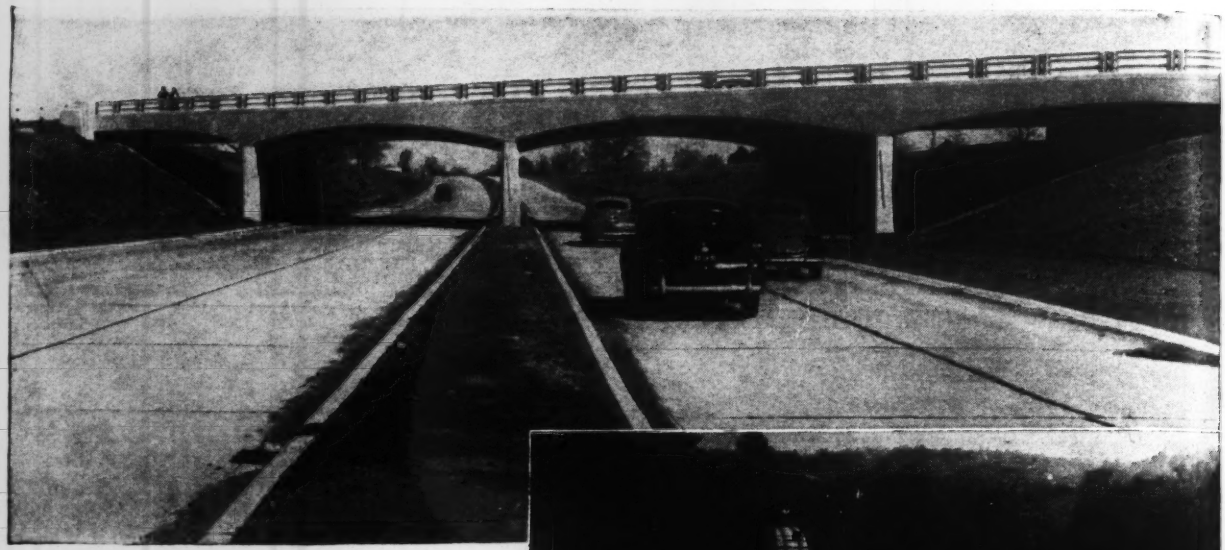

Concrete gives *low annual cost* service on urban limited highways such as Detroit's Industrial Expressway.

Concrete also provides strength and economy for rural roads such as this section of U. S. Highway 209 in Monroe County, Pennsylvania.

CONCRETE gives low-annual-cost pavement service

The strength and stamina of portland cement concrete pavement enables it to give long years of all-weather service.

For all but the lighter traffic, concrete pavement designed according to sound engineering principles usually costs less to build than any other pavement of equal load-carrying capacity.

LOW MAINTENANCE COST

Although the smooth-riding and all-weather safety of concrete roads generally attract the heaviest traffic, annual maintenance costs of concrete pavement have been lower than for other types of paving. This was true even during the war years when concrete roads had to carry heavy overloads of industrial traffic.

LOW ANNUAL COST

Low first cost, low maintenance expense and long life mean *low annual cost*—the reason why portland cement concrete is the logical pavement for new principal urban and rural highways and streets.

Write for data on latest concrete pavement designs for roads and streets. Free in United States and Canada.

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Dept. A1b-17, 33 West Grand Ave., Chicago 10, Illinois

A national organization to improve and extend the uses of concrete . . . through scientific research and engineering field work

Construction Trends

1946 Waterworks Contracts 36% Greater Than Average Peace Year

Volume of waterworks contracts in 1946, totalling $109,159,000, is the fourth highest annual waterworks volume recorded by *Engineering News-Record*. It is 36 percent higher than the average prewar year of $80,467,000, and 50 percent greater than the average war year of $72,961,000.

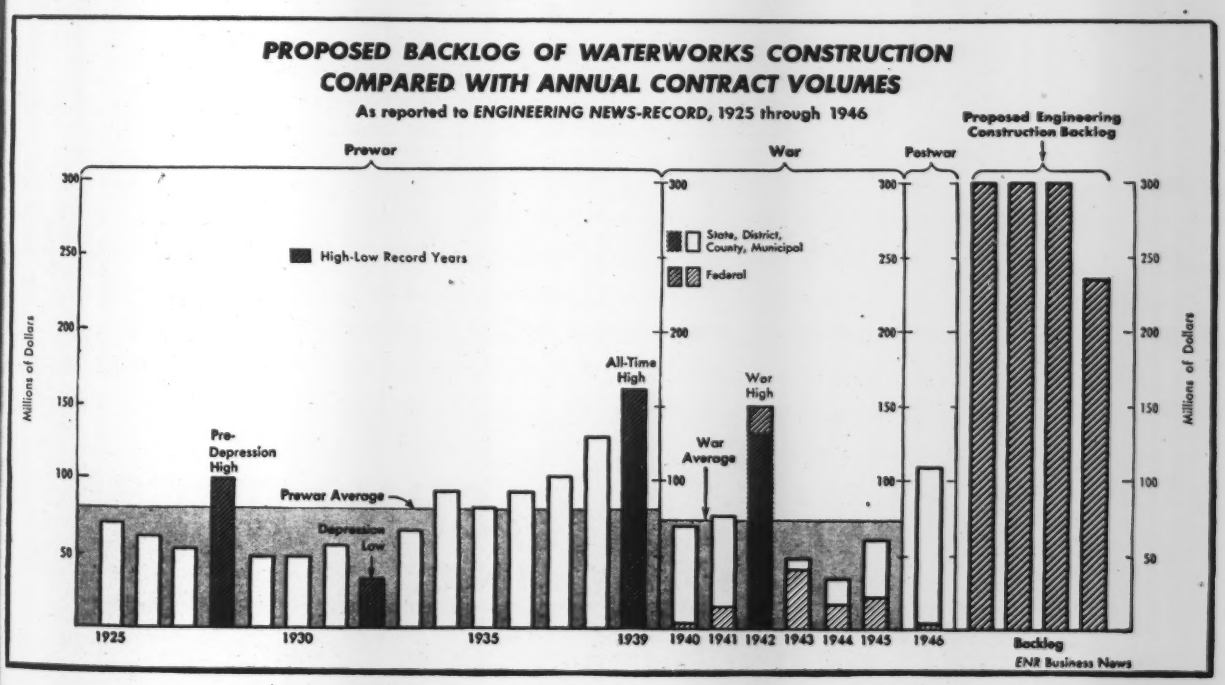
The total of 1946 waterworks contract awards was exceeded in 1938 when new waterworks contracts totalled $131,000,000; in 1939, the all-time high year, with a volume of $163,000,000; and in the war-high year of 1942, when awards reached $151,000,000.

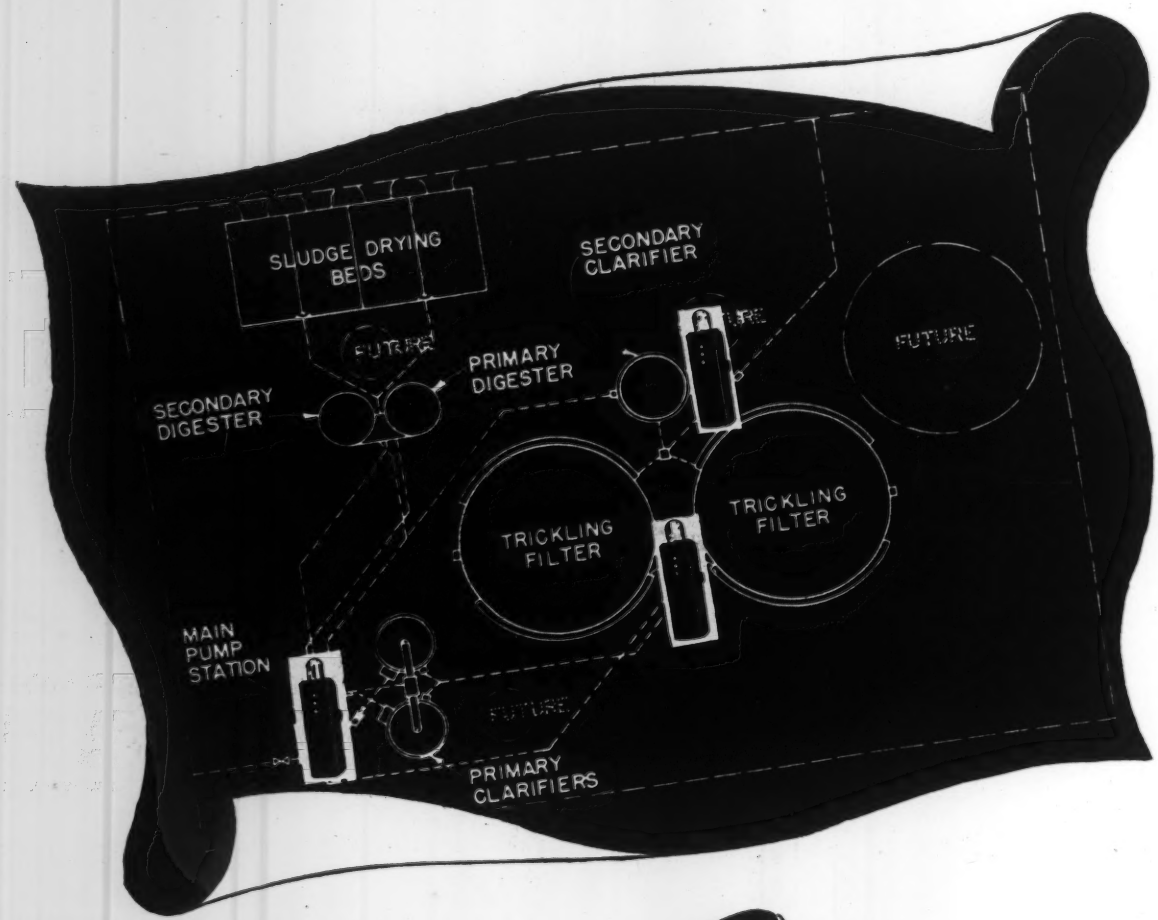
Federal waterworks contracts, amounting to $3,450,000, were only 3 percent of all waterworks in 1946, while the remaining 97 percent, or $105,709,000, was spent for state, district, county and municipal work. In 1945, 36 percent or $21,857,000, was federal work, and 64 percent, or $39,182,000 was state, district, county, and municipal work.

Included in the classification of waterworks construction are reservoirs, tunnels, supply pipe, pumping plants, treatment plants, water tanks, standpipe, and distribution systems. Some of the larger contracts awarded this past year are: Merriman Dam in Wawarsing, N. Y., $14,300,800; water supply lines, supply wells, steel elevated tank and tower in Ysleta, Texas, $1,807,665; water supply line in Wichita Falls, Texas, $1,449,686; pipeline from Lakeside to Grossmont Tunnel in San Diego, California, $1,315,708; cut-off trench, cut-off wall, and embankments for Neversink Dam in New York, N. Y., $4,076,600; filtration plant in Savannah, Ga.; $2,110,000; and water supply line, submerged crib, and two pumping stations in Saginaw, Mich., $5,203,326.

In 1946, the Middle Atlantic states rolled up a total of $29,264,000 in new waterworks contracts, 26 percent of all waterworks awards in the United States. Other sections recorded the following totals: Middle West, $21,396,000, 20 percent; West of Mississippi, $19,828,000, 18 percent; South, $17,293,000, 16 percent; Far West, $17,166,000, 16 percent; and New England, $4,212,000, 4 percent.

At the end of 1946, the backlog of proposed waterworks projects amounted to $1,131,173,000. This reservoir of needed improvements remained after $41,347,000 was deducted as projects advanced from the "proposed" classification to "contract award" status during the year. Even if no contracts were awarded except from this reserve, the backlog would be sufficient to provide 11 years of waterworks construction at 1946 volume.



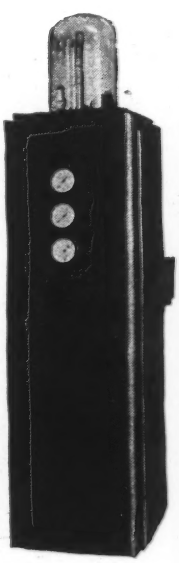


PENNY WISE? SURE— BUT POUND WISE, TOO, WITH *Chlorination*

A sewage treatment plant built today is generally planned for the future. It is a sizeable investment yet many estimates must be made in its design and construction. If the estimate of future needs is too high, money will be wasted in excess capacity and if the estimate is too low the whole plant may be outgrown before it has served its useful life.

Adequate chlorination included in the original design, however, is useful in *any* plant. It can go a long way toward turning estimates into facts—toward giving the results of increased plant capacity with only a negligible increase in building costs. It is an added safety factor to help cover the unpredictables in population growth and industrial trends.

Whether you're building a new plant or modernizing an existing one, plan on the extra, low cost advantages of chlorination in meeting more stringent stream control standards and to give you added plant capacity.



"The Only Safe Sewage is a Sterilized Sewage"

WALLACE & TIERNAN COMPANY, INC.

MANUFACTURERS OF CHLORINE AND AMMONIA CONTROL APPARATUS
NEWARK 1, NEW JERSEY • REPRESENTED IN PRINCIPAL CITIES

New Construction Volume in December

Civil engineering construction volume in continental United States totals $352,855,000 for December, an average of $88,213,000 for each of the four weeks of the month. This average is 28 percent above the average for November, and is 48 percent above the average of December, 1945, according to *Engineering News-Record.*

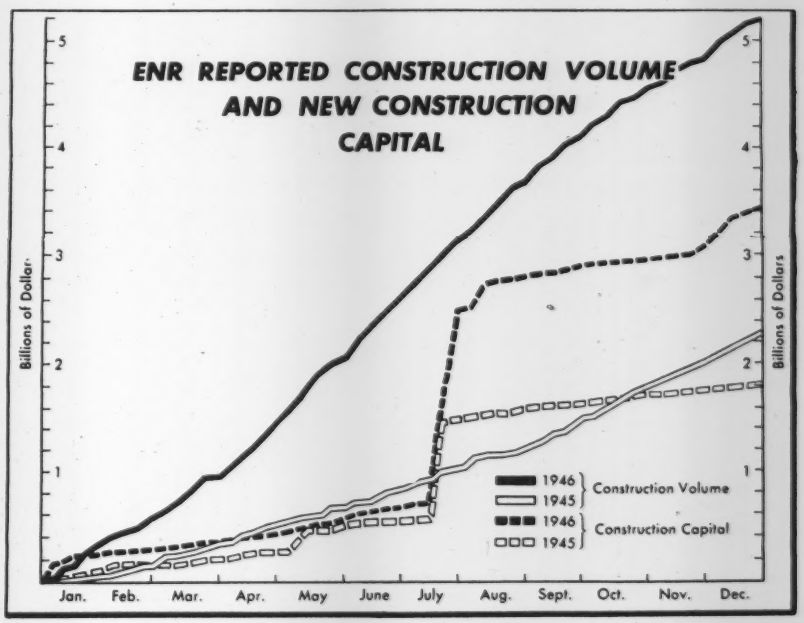
Private construction for December on a weekly average basis is 83 percent above last month, and 43 percent greater than December, 1945. Public construction is 24 percent below last month, and 62 percent above last December. State and municipal construction, while 12 percent above last month, is 114 percent above the average for December, 1945. Federal construction, down 81 percent from last month, is 51 percent below December, 1945.

Weekly averages in the various classes of construction for December, 1946 compared with November, show gains in industrial buildings, of 387 percent; waterworks, 32 percent; public unclassified, 40 percent; and private unclassified, 77 percent; losses in highways, 2 percent; public bridges, 18 percent; sewerage, 17 percent; earthwork and drainage, 64 percent; public buildings, 43 percent; and commercial buildings, 9 percent.

Geographically, five sections showed gains in December, 1946 over November—New England, 33 percent; Middle Atlantic, 22 percent; South, 229 percent; Middle West, 30 percent; West of the Mississippi, 18 percent. Far West dropped 57 percent below November.

Four sections made gains in December over December, 1945— Middle Atlantic, 114 percent; South, 387 percent; West of the Mississippi, 5 percent; Middle West, 1 percent. New England dropped 4 percent below last year, and Far West 40 percent.

New capital for construction purposes for the four weeks of December, 1946 totals $314,558,000. On a cumulative basis, new construction capital in 1946 totalled $3,407,681,000, 87 percent greater than the 1945 total of $1,824,026,000.



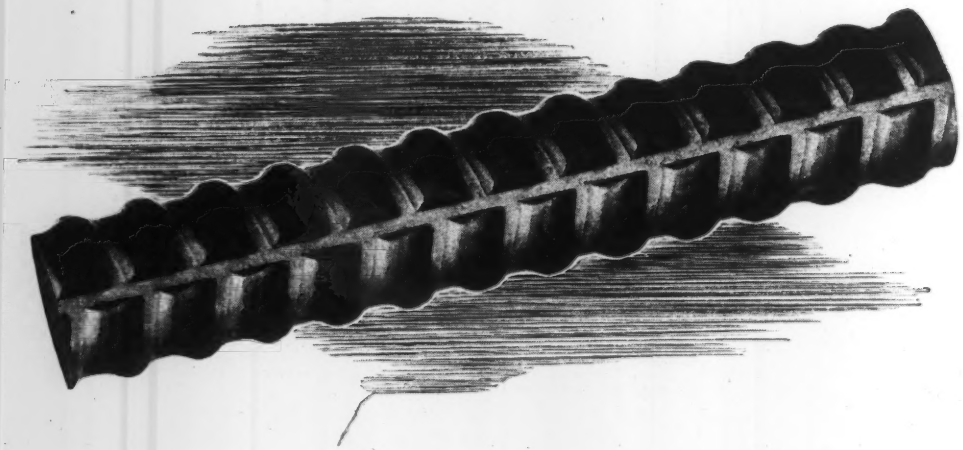
ENGINEERING CONSTRUCTION CONTRACTS REPORTED TO ENGINEERING NEWS-RECORD—DECEMBER, 1946

Engineering News-Record *reports continental U. S. Construction projects of the following minimum costs — Waterworks, excavation, drainage and irrigation,* $22,500; *other public works,* $40,000; *industrial buildings,* $55,000; *other buildings,* $205,000

Four Weeks — Thousands of Dollars (000 Omitted)

	New England	Middle Atlantic	South	Mid West	West of Mississippi	Far West	United States December	United States Twelve Months 1946	United States Twelve Months 1945	Canada
Public Works										
Waterworks	58	3,513	1,589	824	644	1,117	7,745	109,159	61,039	614
Sewerage	102	1,150	2,389	1,025	2,464	623	7,753	113,589	34,560	267
Bridges, public	244	1,210	1,622	1,070	1,105	831	6,082	126,579	49,099	.....
Earthwork and waterways	.....	256	4,936	209	407	2,569	8,377	327,605	56,759	2,299
Streets and roads	5,923	7,040	8,918	7,865	12,220	1,840	43,806	769,387	227,258	83
Buildings, public	12	11,484	1,875	7,353	2,976	2,253	25,953	414,087	462,909	1,814
Unclassified, public	291	5,784	255	143	64	295	6,832	157,957	253,400	2,733
Total public	6,630	30,437	21,584	18,489	19,880	9,528	106,548	2,018,363	1,145,024	7,810
Federal government (inc. in above classifications)	12	55	1,027	5,000	959	3,163	10,216	599,271	750,000	.....
Private										
Bridges, private	.....	.....	.....	.....	.....	.....	.....	2,092	3,981	.....
Industrial buildings	1,877	13,414	59,170	24,261	40,158	4,617	143,497	1,113,251	635,170	12,276
Commercial buildings	3,745	37,853	21,290	2,125	7,390	15,596	87,999	1,846,173	387,273	1,150
Unclassified, private	445	120	9,321	405	4,262	258	14,811	196,155	117,960	555
Total private	6,067	51,387	89,781	26,791	51,810	20,471	246,307	3,157,671	1,144,384	13,981
Total Engineering Construction:										
December, 1946 — 4 weeks	12,697	81,824	111,365	45,280	71,690	29,999	352,855	.....	.....	21,791
November, 1946 — 4 weeks	9,519	66,995	33,865	34,756	60,976	69,714	275,825	.....	.....	15,887
December, 1945 — 4 weeks	13,240	38,210	22,885	44,968	68,305	50,401	238,009	.....	.....	12,933
Twelve Months — 1946	292,508	1,228,326	864,146	432,825	1,041,363	1,116,866	.....	5,176,034	.....	310,101
Twelve Months — 1945	98,998	428,900	306,838	429,100	498,506	527,066	.....	.....	2,289,408	164,061

The Bar that Checked A Thousand Slips



Hi-Bond Reinforcing from Ryerson

Ryerson steel-service plants, first to carry Hi-Bond re-bars in stock, are still your best source for this unique reinforcing bar. You order Hi-Bond cut, bent, formed and fabricated. We prepare the steel accurately to your specification . . . tag each bundle for easy placement . . . schedule deliveries with the progress of your job.

Today, great demand sometimes depletes our stocks of many sizes but it will pay you to use Hi-Bond when available. Laboratory tests show that the increased bonding strength of Hi-Bond provides greater resistance to slip—72% greater than conventional bars. The result: better control of concrete cracks, reduced deflection of beams and less deformation of columns.

The advantages of Hi-Bond are job-proved, too. Since its introduction less than three years ago, Hi-Bond's ability to out-perform other reinforcing bars has been demonstrated on hundreds of construction projects. On jobs requiring a few pounds of bars and others using hundreds of tons, contractors report better anchorage, and less cracking due to scientific Hi-Bond design, and greatly reduced tying costs because of the interlocking action of one Hi-Bond bar with another.

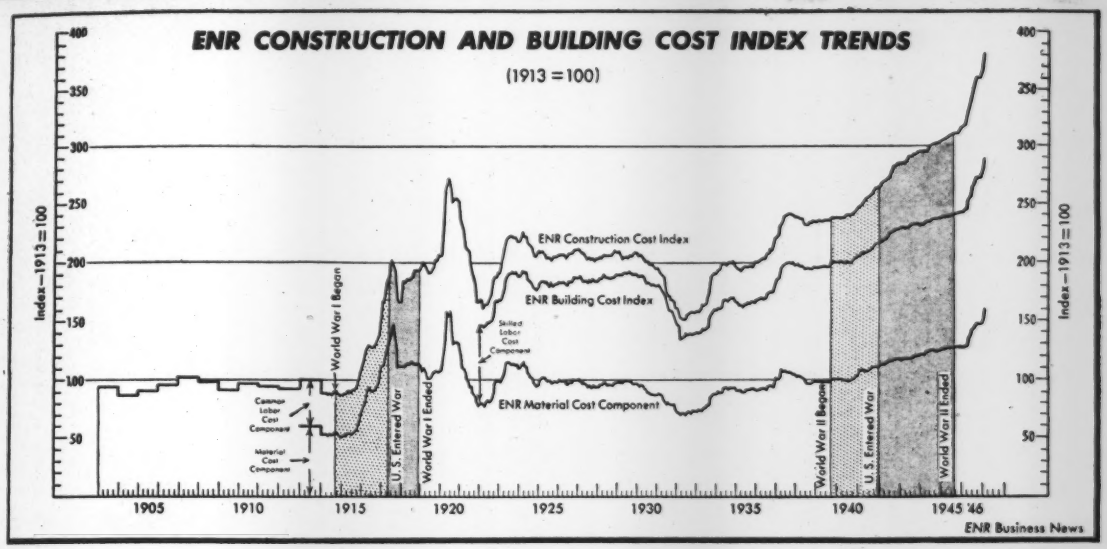
In addition to Hi-Bond, Ryerson plants carry a wide range of construction steels in stock—reinforcing accessories, structurals, plates, wire fabric, steel spirals, etc. Contact the plant nearest you for prompt, versatile steel service.

Joseph T. Ryerson & Son, Inc., Steel-Service Plants: New York, Boston, Philadelphia, Detroit, Cincinnati, Cleveland, Pittsburgh, Buffalo, Chicago, Milwaukee, St. Louis, Los Angeles.

RYERSON STEEL

JANUARY CONSTRUCTION BUSINESS REPORT

ENR CONSTRUCTION AND BUILDING COST INDEX TRENDS



ENR CONSTRUCTON VOLUME AND NEW PRODUCTIVE CAPITAL

Thousands of Dollars (,000 omitted)	December 1945 (4 wk.)	December 1946 (4 wk.)	% Change	Twelve Months 1945 (52 wk.)	Twelve Months 1946 (52 wk.)	% Change
Total U. S. Construction	$238,009	$352,855	+48	$2,289,408	$5,176,034*	+126
Private Construction	172,370	246,307	+43	1,144,384	3,157,671	+176
Public Construction	65,639	106,548	+62	1,145,024	2,018,363*	+76
Federal	20,677	10,216	−51	750,000	599,271*	−20
E N R Construction Volume Index, 1913 = 100	163	207	+27	123	250	+103
Total New Productive Capital	$71,189	$314,558	+342	$1,824,026	$3,407,681	+87
Private Investment	71,189	314,558	+342	610,528	1,509,699	+147
Federal (non-federal work)	.....	.....	.....	163,600	225,000	+38
Federal (federal work)	.....	.....	.....	1,049,898	1,672,982	+59

* Revised.

CONSTRUCTION COST . . . . WAGE RATES . . . . MATERIAL PRICES

1913 = 100	January 1946	January 1947	% Change	Change December to January: Dec. 1945	Jan. 1946	%	Dec. 1946	Jan. 1947	%
E N R Constr. Cost Index†	316.32	381.68	+20.66	313.48	316.32	+0.91	368.10	381.68	+3.69
E N R Building Cost Index†	242.23	288.78	+19.22	240.82	242.23	+0.59	278.49	288.78	+3.69

† *Does not reflect increased costs due to overtime, lower labor efficiency, delivery delays, etc.*

ENR 20-CITIES' AVERAGE

Common Labor	$0.953	$1.109	+16.37	$0.938	$0.953	+1.6	$1.085	$1.109	+2.21
Skilled Labor (Av. 3 Trades)	1.701	1.885	+10.82	1.681	1.701	+1.2	1.863	1.885	+1.18
Bricklayers	1.787	1.996	+11.70	1.772	1.787	+0.8	1.974	1.996	+1.11
Structural Ironworkers	1.748	1.898	+8.58	1.729	1.748	+1.1	1.876	1.898	+1.17
Carpenters	1.567	1.753	+11.87	1.550	1.567	+1.1	1.736	1.753	+0.98
Cement, per barrel	2.740	3.302	+20.51	2.740	2.740	0	3.154	3.302	+4.69
Reinforcing Steel, cwt.	2.790	3.364	+20.57	2.790	2.790	0	3.357	3.364	+0.21
Structural Steel, base	2.100	2.350	+11.90	2.100	2.100	0	2.350	2.350	0
Sand, per ton	1.250	1.559	+24.72	1.250	1.250	0	1.529	1.559	+1.96
Lumber, 2x4 Fir, per M ft.	54.990	80.516	+46.42	54.580	54.990	+0.8	72.172	80.516	+11.56
Lumber, 2x4 Pine, per M ft.	54.550	76.471	+40.19	53.440	54.550	+2.1	67.739	76.471	+12.89
Common brick, per M	19.910	23.150	+16.27	19.910	19.910	0	22.325	23.150	+3.70
Ready-mixed concrete, c.y.	7.640	8.523	+11.56	7.640	7.640	0	8.438	8.523	+1.01
Struct. clay tile, 3x12x12	89.220	102.186	+14.53	89.220	89.220	0	98.673	102.186	+3.56

MATERIAL SHIPMENTS . . . . BUILDING PERMITS

	December 1945	December 1946	% Change	November 1946	% Change November to December
Steel (% operating Capacity) A.I.S.I.	77.3	74.9	−3	86.1	−13

	October 1945	October 1946	% Change	Ten Months 1945	Ten Months 1946	% Change
Cement, thous. bbl. U.S.B. of Mines	13,303	17,721	+33	89,946	143,039	+59

	November 1945	November 1946	% Change	Eleven Months 1945	Eleven Months 1946	% Change
Fabricated Structural Steel, tons, A.I.S.C.	59,935	144,488	+141	687,500	1,384,341	+101
Building Permits, 215 Cities, Dun & Bradstreet (,000 Omitted)	$163,370	$158,080	−3	$1,054,012	$2,408,349	+128

COST OF LIVING INDEX . . . EMPLOYMENT

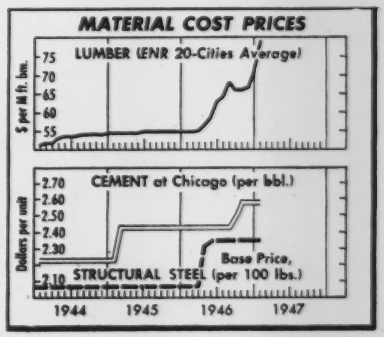
	November 1945	November 1946	% Change	October 1946	% Change October to November
Consumers' Price Index, B L S	129.3	151.7	+17.3	148.4	+2.2
Rent (Housing) Index B L S	108.3	108.8	+0.5	108.8	0

	December 1945	December 1946	% Change	November 1946	% Change November to December
Const. Employment (est.), thous., B L S	1,215	1,915	+57.6	2,065	−7.3
Private Const. Employ. (est.), thous., B L S	1,021	1,512	+48.0	1,610	−6.1

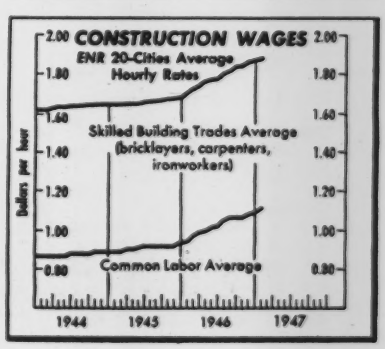
ENR INDEX NUMBERS

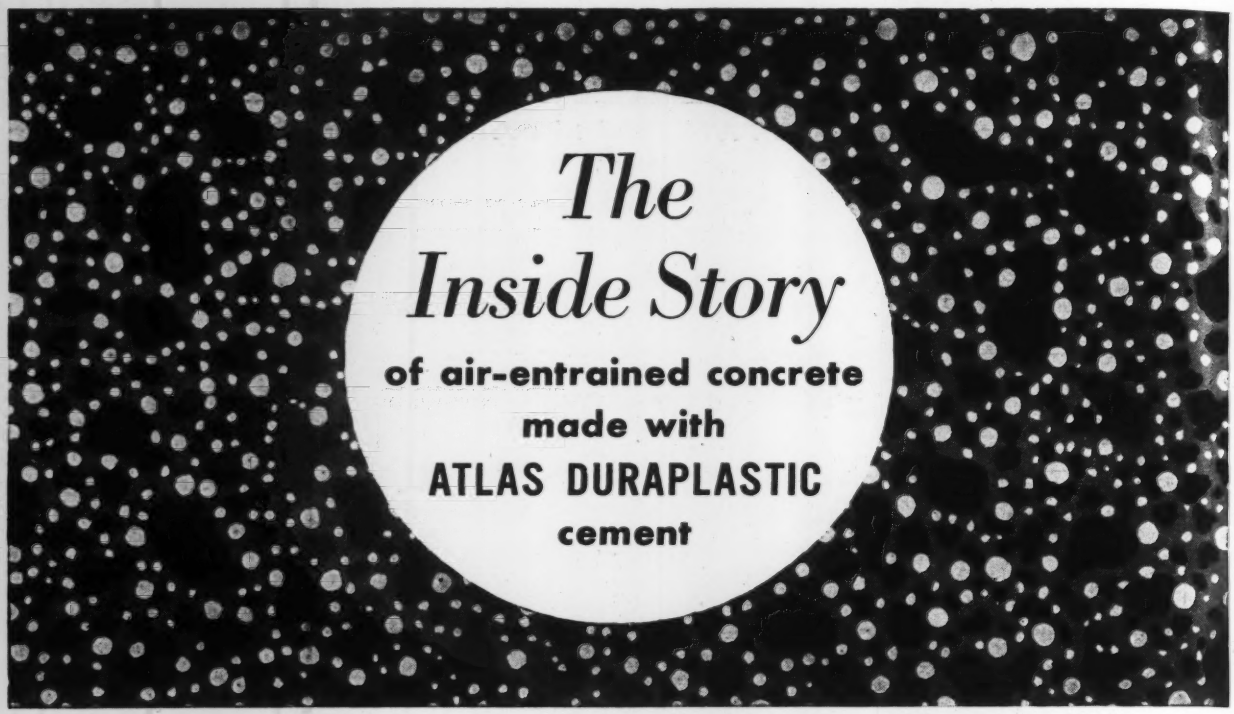
Base = 100	Construction Cost 1913	Construction Cost 1926	Building Cost 1913	Building Cost 1926	Volume '13	Volume '26
Jan., 1947	381.68	183.47	288.78	156.11	..	..
Dec., 1946	368.10	176.95	278.49	150.54	207	91
Nov., 1946	362.47	174.24	273.71	147.96	164	72
Oct., 1946	360.94	173.50	272.74	147.43	233	102
Sept., 1946	360.19	173.14	272.04	147.06	223	98
Aug., 1946	361.37	173.71	271.98	147.02	258	113
July, 1946	353.89	170.11	266.13	143.86	327	144
June, 1946	347.91	167.24	264.16	142.80	344	151
May, 1946	339.69	163.29	257.25	139.06	284	125
April, 1946	334.59	160.83	254.37	137.50	340	149
Mar., 1946	323.83	155.66	245.41	132.66	256	112
Feb., 1946	319.52	153.59	243.94	131.86	167	73
Jan., 1946	316.32	152.05	242.23	130.94	189	83
Dec., 1945	313.48	150.69	240.82	130.18	163	71
Nov., 1945	309.28	148.67	240.55	130.00	173	76
1946 (Av.)	345.74	166.19	261.87	141.55	250	110
1945 (Av.)	307.74	147.93	239.14	129.27	123	54
1944 (Av.)	298.63	143.39	234.73	126.89	95	42
1943 (Av.)	289.95	139.38	228.75	123.66	176	77

MATERIAL COST PRICES



CONSTRUCTION WAGES





If you were looking through a microscope at a cross-section of concrete made with Duraplastic cement, you would see something like this. Black spots represent aggregate; grey area—cement and sand; white dots—entrained air bubbles.

Duraplastic cement provides the proper amount of entrained air by intergrinding with the cement the precise amount of air-entraining material needed for satisfactory field performance.

It requires less mixing water and reduces segregation and bleeding.

It makes the concrete more workable, more plastic, more cohesive, more uniform and more durable.

For almost any type of concrete work, Duraplastic cement makes better concrete at no extra cost. It complies with ASTM and Federal specifications, and sells at the same price as regular cement.

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ENR-D-47

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News of the Week

ENGINEERING NEWS-RECORD • JANUARY 9, 1947 • VOLUME 138 • NUMBER 2

Urge U. S. aid to complete Inter-American Highway

House committee report scores Army Engineers for procedure followed but urges appropriation of funds estimated at $27 million for completion of work

Because of the large benefits that would result, the United States should provide financial assistance to complete the Inter-American Highway through Central America, the House Roads Commitee of the last Congress recommended in an 84-page report released recently.

The report severely criticizes the Corps of Engineers for the procedure followed in the work they did on the road during the war (*ENR* July 29, 1943, vol. p. 209, Aug. 12, vol. p. 269, and Aug. 26, vol. p. 339).

Good progress has been made, the report states, in providing a highway from Laredo, Texas, to the Panama Canal Zone—a distance of 3,356 miles. Except for gaps of about 150 miles in lower Mexico, 115 miles in northern Costa Rica, and 125 miles in southern Costa Rica and upper Panama the entire route is passable in all seasons. With the closing of these three gaps—plus minor improvement of some existing sections—an all-weather route to the Canal Zone, suitable for commercial and tourist traffic, would be available.

"A promise was implied in the program instituted by the War Department," the report says. "This promise can be kept only through further financing by the United States in cooperation with the Central American republics. Economic and social benefits to be derived from an early completion are believed by the committee to be self-evident."

Cost estimates needed

However, the committee recommends that the U. S. should first secure up-to-date cost estimates for the uncompleted work. It also recommends that any future authorized construction should take full advantage of the work already done by the Army Engineers, the Public Roads Administration and the Central American republics. It is further suggested that the unfinished sections should be completed before attempting to greatly improve the existing links.

According to an estimate submitted to the committee by the War Department, an additional expenditure of $27,000,000 will be required to finish the road as originally proposed.

The figures supplied by the War Department the committee said, also show that the Army Engineers work cost much more than the original estimate and progress was not nearly as much as had been anticipated in early reports.

The War Department, on the basis of inadequate information, originally estimated that its project would cost $15,000,000, but when work was shut down in Oct. 31, 1943, only 58 percent of the project was completed and this had been accomplished at a cost of approximately $36,000,000. The assignment of the Engineers called for construction of 459.7 miles of new road and improvement of about 404 miles of existing road by widening, elimination of curves, and other major improvements. Operations were confined to the six Central American republics, no work being done in Mexico.

Planning criticized

The general planning for the project is criticised as follows: "In view of the position taken by the War Department General Staff that this project was not an urgent military necessity, the project was assigned a very low priority. It is evident that the qualification requiring

(*Continued on page* 55)

Truman asks housing, labor program

An aggressive legislative program to encourage home construction at a greatly accelerated rate by private industry was demanded by the President in his message on the state of the union to Congress Jan. 6. He also asked for comprehensive legislation to permit "greater harmony between labor and management."

The President reported that in 1946 one million housing units were placed under construction, and more than 665,000 units were completed. However, he stressed that this was not enough and added that in 1947 he hopes that the number of homes completed will approach—if not surpass—the top home construction year of 1926.

"The primary responsibility to deliver housing at reasonable prices that veterans can afford rests with private industry and labor," Mr. Truman told Congress.

However, to reach the housing goal desired, the Chief Executive asked for "comprehensive" housing legislation. "At a minimum, such legislation should open the way for rebuilding the blighted areas of our cities and should establish positive incentives for the investment of billions of dollars of private capital in large-scale rental housing projects."

"It should provide for the improvement of housing in rural areas and for the construction, over a four-year period, of half a million units of public low-rental housing. It should authorize a single peacetime federal housing agency to assure efficient use of our resources on the vast housing front."

To reduce labor-management strife, this program was suggested:

Early enactment of legislation to prevent certain unjustifiable practices, such as boycotts and jurisdictional strikes; extension of the facilities within the Department of Labor for assisting collective bargaining; broadening of the program of social legislation to alleviate the causes of workers' insecurity, and the appointment of a temporary joint commission to inquire into the entire field of labor-management relations.

NEWS IN BRIEF

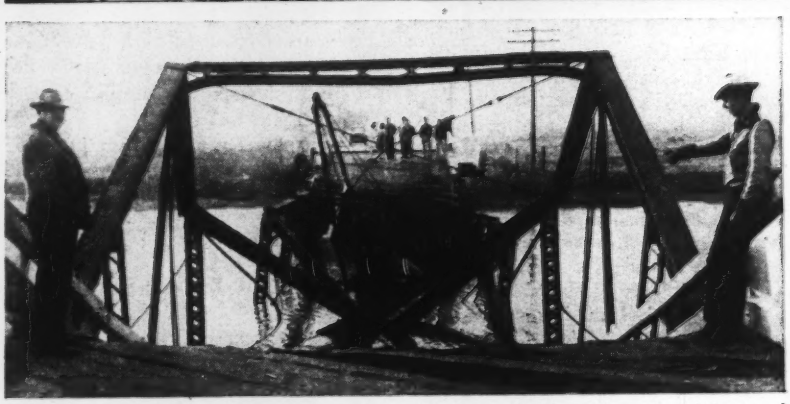
In telegraphic form, here are latest news developments on the engineering and construction front during the week.

Construction — The *Pennsylvania* Department of Welfare has announced a $16,000,000 building program at the State Hospital, *Philadelphia*, including a $2,000,000 patients' building. Another big building planned for that city is a $6,500,000 structure for the Philadelphia Wholesale Produce Terminal. . . . Additional plant and equipment to cost $6,000,000 is planned for this year by John A. Roebling's Sons Co. at *Trenton, N. J.* . . . The Indiana Bell Telephone Co., *Indianapolis*, plans to spend $50,000,000 within the next three years for expansion and improvements —$6,000,000 this year . . . Interstate Cotton Oil Refining Co., of Sherman, Tex., will erect a $2,000,000 vegetable oil processing plant at *Hannibal, Mo.* . . . Scott Paper Co., *Chester, Pa.*, is building a $1,500,000 boiler house . . . The Department of Welfare has plans for a $2,500,000 security prison at *Gratersford, Pa.* . . . Applications have been filed for building permits to cover an immediate $2,000,000 expansion and modernization program for bus terminals, shops and administrative offices of the *Baltimore, Md.*, Transit Co. . . . Among the *Chicago* area companies announcing construction plans are: The Hotpoint Division of General Electric Co., Standard Asbestos Mfg. Co., Clawson & Bals, Inc., Barber Greene Co., Hibbard, Spencer, Bartlett & Co., Corn Products Refining Co., Kellogg Switchboard & Supply Co., Jefferson Electric Co., Fastener Corp., C. L. Barkley & Co., Universal Form Clamp Co., Kimble Glass Co., D. & S. Mold & Tool Co., Great Lakes Warehouse Corp., Weirton Engineering Co., Dole Refrigerating Co., Concrete Joist Co., General Can Co., Batson Bros. Co., the Set Screw and Mfg. Co., Continental Chain Co. Such developments for the year 1946 amount to $184,438,000, the largest dollar value recorded in any peacetime year since 1939.

Housing—Home builders of *Atlanta, Ga.*, are planning to start a program to provide 4,700 new home and apartment units in 1947 at an estimated cost of $36,000,000 . . . Plans for over 2,000 homes to cost between $6,000 and $8,000 each in the *Peoria, Ill.*, area are being considered by the Caterpillar Tractor Co. . . . Zoning difficulties may prevent a proposed 500-home $5,000,000 housing project on the Dhu Varren Farm a mile north of *Ann Arbor, Mich.*, with the Ann Arbor Township Board voting recently against rezoning the area from agricultural to residential. The H. C. Allen Co., promoters of the project, which called for construction of steel-panel houses, has two alternatives —contest the zoning decision or seek annexation by Ann Arbor.

Highways—The *Kentucky* highway department reported that 1946 was a banner year for road building, with 192 projects finished or in process, at a total cost of $18,185,800 . . . Improvements on the *Illinois* state highway system totalling $12,399,000 were completed in 1946 . . . *Alabama* state highway department on Jan. 10 will receive bids on road and bridge projects to cost an estimated $2,800,000. . . . *Waterbury, Conn.*, will spend $293,000 for new and resurfaced streets.

Sewers and water supply—Work is starting soon on the new water treatment plant of the Pinellas Water System at *Clearwater, Fla.* . . . *Abington Township, Pa.*, has awarded $583,426 in contracts for a sewage treatment plant . . . Bids have been received on a $2,650,000 sewer project at *Bloomington, Ill.* . . . An engineers' report will recommend an outlay of $35,000,000 over a period of years for sewer construction at *Indianapolis, Ind.* . . . Waterworks and sewerage bonds have been voted at *Statesboro, Ga.* . . . *Chester, Pa.*, will construct a new water supply system to cost about $8,400,000. A dam and basin of 500 acres will be built at Pine Grove . . . *Cleveland, Ohio*, will seek bids on the Nottingham reservoir and temporary pumping station. . . . *Waterbury, Conn.* plans to spend about $1,000,000 in 1947, including $65,000 for water mains, $175,000 for sewer extensions, and $350,000 for a sewage interceptor.



***Trucks vs Bridges**—Two 19th century highway bridges, one in Maine and the other in California, succumbed to modern-day traffic recently, in unequal conflicts with heavy trucks. At top, heavy truck-trailer was victor when it struck the end-post of the old Rockport Bridge, built in 1884 over the Goose River on U. S. highway No. 1 in Maine. One of the oldest metal bridges in the state, the structure was pushed from its support. Below, a 50-year-old steel structural bridge over King's Slough near Fresno, Calif., collapsed under an apparent overload when a heavy county-owned truck and trailer (almost immersed in the water) reached the center of the 119-ft. span.*

Chicago OK's engineers' salary raises

Recent approval by the finance committee of the Chicago city council of a new salary schedule, embodying general raises for engineers and technical employees is regarded as tantamount to adoption of the plan. It is expected that the new schedule will be put into effect some time this year.

Additional funds are required to take care of salary increases resulting from application of the new rating system. More than 1,000 professional and technical employees of the city are affected. Several months will be required to classify these employees into the nine grades set up by the new schedule. By the time the classification is completed, the city hopes to have the money to pay the higher wages involved.

Chicago faced the necessity of making some improvement in salary scales in order to retain its engineering and technical force, members of which were being tempted to accept other positions at higher pay. After thorough study of the situation, a 6-man advisory committee, under the chairmanship of Arthur G. Lindell, budget director, (comprising, personally or by proxy, the city engineer, the commissioner of subways and superhighways, the county superintendent of highways, the assistant chief engineer of the park district, and the chief engineer of the sanitary district) made a report setting up nine classifications of professional and technical grades and recommending salary ranges for each category. This study, as summarized in the report, received the approval of the city council's finance committee.

Report studied

Before being submitted to the finance committee, the report was subjected to analysis and study by special committees of three separate engineering organizations, the Illinois Section of the ASCE, the Western Society of Engineers, and the Illinois Society of Professional Engineers. All three society committees approved the report in substance and offered only minor recommendations for changes. One of these recommendations, presented by the Illinois Section of the ASCE, proposed that two grades set up for sub-professional work be given a separate status from the seven grades requiring professional capacity. Budget Director Lindell believes that this recommendation can be made effective in the final schedule.

The nine grades in the schedule, as at present set up, run from grade 1 for positions from junior tracer to junior draftsman at compensation of $2,100 to $3,360, up to grade 9, involving direction of all engineering activities for the city, at a salary of $11,000 to $15,000. Compensation recommended for the nine grades is as follows: grade 1, $1,100—$3,360; grade 2, $3,360—$4,200; grade 3, $4,200—$4,800; grade 4, $4,800—$5,580; grade 5, $5,580—$6,420; grade 6, $6,600—$7,500; grade 7, $7,560—$9,500; grade 8, $9,500—$11,000; grade 9, $11,000—$15,000.

The rates set up for Chicago's engineering employees are slightly lower than those recommended recently by the American Society of Civil Engineers (*ENR* Oct. 31, 1946, vol. p. 563). The ASCE, which also set up nine grades of engineering work, recommended salaries starting at $2,700 for Grade I and $12,600 for Grade IX.

Atom power for electric production seen near

The production of commercial electric power through the use of atomic energy at a cost comparable with or even lower than that from most steam central stations was foreseen in the near future in a report to the New England Council of its five-member Atomic Energy Committee.

The committee is headed by William Webster, vice-president of the New England Power Association of Boston, and includes Karl T. Compton, of Massachusetts Institute of Technology.

Its report pointed out that "there seems to be no question, from a technical standpoint, of the possibility of generating large amounts of power from the heat liberated during the operation of atomic piles." The report strongly urged the appropriation of federal funds for research in this field.

Urge funds for Inter-American road

(*Continued from page* 53)

that no critical materials needed for essential military projects were to be committed to the undertaking was a prohibitive qualification to begin with and, as is shown in detail in this report, restrictions in shipping facilities were so stringent that construction was materially delayed from the very inception."

Choice of the key personnel to head the Army work is reported on unfavorably by the committee, which said that these men lacked managerial abilities for a job of such great scope. The officers are also criticised for their choice of contractors to handle the large construction contracts, one of the concerns failing to perform satisfactorily and termination of the contract being necessary.

In contrast, the committee found that splendid and loyal work was done by many of the men and officers on the actual project under the difficult working conditions encountered. The route the Army Engineers selected was also found to be practical from the Army operational viewpoint.

The committee reported that the Contract Negotiation Board of the project often acted hastily and without due regard to the best interests of the U. S. Government in the establishment of rental rates to be paid for the contractor-owned equipment. The procedure followed in approving rental agreements for third-party equipment was also termed unsatisfactory.

The Army Engineers also failed to renegotiate the equipment rental contracts, which resulted in one contractor receiving 424 percent of the original value of his equipment in rental fees, according to the report. Much property was lost or could not be adequately accounted for, and disposal of the equipment and supplies when the work was shut down was also handled poorly by the Army, the committee further found.

The investigation of the House Committee, which called for a trip over the project by Chairman Robinson of Utah and other members, should not be confused with the findings of a special Senate committee in 1945 (*ENR* July 19, 1945, vol. p. 70). This committee's work showed that the late President Roosevelt played an important part in the decision to go ahead with the job as a "Good Neighbor" project to aid the economies of the Central American republics.

Senator calls for stoppage

Another—and much stronger—criticism of work on the highway was voiced earlier in the week in a statement by Senator Homer Ferguson of Michigan, a member of the Senate National Defense Committee.

Speaking to newspapermen, Sen. Ferguson called the highway a "$140,000,000 blunder" and said the PRA should stop construction immediately. He cited the original cost estimates of Army Engineers at $30,000,000, and said the U. S. has already spent $75,000,000 on the work, with prospect of another $65,000,000 additional expenditure for completion.

Set $25 million Boston port expansion

Seeking to put its port facilities on a par with those of any major deepwater port on the Atlantic seaboard, the Port of Boston Authority last week announced a $25,000,000, ten-year construction program.

Scheduled to get under way in the next two months is construction of a new ocean terminal to be known as Hoosac Pier No. 1, a $3,600,000 structure on the site of the old Hoosac docks in Charlestown. The new terminal will have facilities to berth three large cargo ships at a time.

Other improvements scheduled, port authority officials indicated, include:

Improvement of existing facilities at the Mystic docks in Charlestown; further improvements at the Boston and Albany terminals in East Boston, and improvements at the recently-acquired Castle Island terminals.

Ending what it termed a "highly successful year" of 1946—despite prolonged maritime strikes and the continued non-operation of several coastwise shipping firms—authority officials said planned increases in service during 1947 would justify the improvements. A year-end tabulation showed that during 1946 the port handled more than 1,143,000 short tons of export and import cargos, some 127,000 short tons of coastal cargos, and somewhat below the normal passenger traffic.

Airline traffic up

While steamship lines were reporting very small passenger traffic lists, due, the authority said, to lack of ships and carried-over wartime restrictions, major airlines serving the city reported that more than 1,000,000 passengers used their facilities at the city's airports during the last year, while another 250,000 arrived or departed from the airfields via private planes, charter trips, or in government-owned transports. All airlines, too, reported that they plan to expand their services as soon as facilities become available.

Pennsylvania may raise gasoline tax

Pennsylvania highway users were warned last week that it may be necessary to raise state gasoline tax rates to support a $137,000,000 1947 road and bridge construction program. At the same time, the Virginia road bureau noted rapidly-rising costs and warned of continuing increases as maintenance and construction are expanded.

State Authorities warned that the commonwealth may not be able to go ahead with the 5-year construction program as planned unless the present tax of four cents a gallon on gasoline is increased, probably to five cents.

This proposed increase would boost the total tax to 6½ cents a gallon, including the federal tax of 1½ cents.

Included in the road projects for the Pittsburgh area and other sections of western Pennsylvania are these:

Construction of 4.03 miles on U. S. Route 19 in Washington County.

Construction of 2.53 miles on Traffic Route 31 in Westmoreland County.

Erection of the substructure of the West Elizabeth Bridge on Traffic Route 51.

Construction of 2.11 miles along Ardmore Blvd. on U. S. Route 30—part of the Penn-Lincoln Parkway, East Pittsburgh area.

Elimination of a grade crossing over the Baltimore & Ohio Railroad track in Finleyville.

In addition, other sections of the Penn-Lincoln parkway may be placed under contract during the year. About three million dollars worth of work on this job is under way now.

Heavy expenditures, particularly for the repair of thousands of miles of Virginia highways damaged by the severe winter of last year, with resultant dwindling cash reserves, were the outstanding items listed in the recent annual report of the State Highway Department.

The report submitted by James A. Anderson, the highway commissioner, showed that the department started the current fiscal year with a cash balance of $20,833,000, a net increase of around $1,000,000 over its balance for the preceding year.

Expenditures, the report said, are now greatly exceeding receipts, due to the return of thousands of highway workers from the armed forces and the restoration of their old jobs. This increase in personnel, as compared with the war years, has stepped up the operations of the department, Mr. Anderson said, and increased expenditures because of the wider scope of work on the roads.

SIGNS OUT

New York State's Department of Public Works said last week it had made arrangements for the removal or alteration of many advertising signs bordering state highways.

The attack is to be twofold, Charles H. Sells, superintendent of public works, said. One phase will be aimed at removal of privately-installed signs on publicly-owned right-of-way; and the other at removal or alteration of signs on private land which have been found to obstruct visibility or to be otherwise hazardous to traffic.

Two Buffalo viaducts to be reconstructed

Advised that the city's application to the Federal Works Agency for planning funds had been approved, Buffalo, N. Y., city officials said last week that reconstruction of the Babcock and South Park Avenue viaducts will be started soon.

Because of its rundown condition, the South Park viaduct was recently closed to larger vehicles, and the Babcock Street structure has been closed for two years.

Commissioner Elwin G. Speyer, of the city's public works department, said that the question of financial responsibility for the work must still be settled through court actions now pending in the state Court of Appeals. Railroads over which the viaducts carry vehicular traffic, as well as city officials, have asked court determination of liability for costs.

Union sues contractor for portal-to-portal pay

In one of the first "portal-to-portal" pay suits filed against a construction industry member as a consequence of recent Supreme Court decisions, union metalworkers last week filed an action seeking such payments for workers in the J. A. Jones Construction Co.'s shipyard at Brunswick, Ga.

The suit asks pay of not less than $405 each for employees who worked continuously from Feb. 1, 1943 to June 17, 1946. A total of 41 employees—all members of the Glynn Metal Trades Council (AFL) and affiliated groups—were named in the suit, each man suing in his own right as well as for all other employees of the shipyard. Union officials estimated that more than 15,000 workers would be affected.

Officials said that the $405 represented time and a half for about 15 minutes of unclocked time daily.

Highway work seen lagging in 1946 despite record dollar volume

Year-end report by Public Roads Administration blames shortages, high bids, lack of engineer personnel for low completion rate

The nation's extensive program of highway repair and construction lagged behind goals set for it during 1946, despite large dollar-volumes involved, according to a year-end report of the Public Roads Administration.

Thomas H. Macdonald, commissioner, said in the report that labor and material shortages, high bids and lack of adequate engineering personnel in state highway departments were responsible for failure to meet all goals.

"Despite these handicaps," he added, "the dollar volume of work contracted for approached the level of contract lettings for road work in normal years before the war."

(Mr. Macdonald's statement was conservative on this point, in view of figures compiled by Engineering News Record (ENR Jan. 2, vol. p. 1) which showed that highway construction in 1946 broke all previous marks, with a $760,000,000 volume, as compared with the 1940 high of $678,000,000.

Contracts for 43,600 miles

Reports received by PRA from state highway departments showed that contracts awarded during the year called for improvements of 43,600 miles of roadway, at a cost of about $740,000,000. This figure, the report said, includes contracts for work on 17,900 miles of highway included in the federal-aid primary and secondary road systems, at a cost of $512,000,000. Projects financed entirely with state and local funds called for expenditures of $228,000,000 for improvements on 25,700 miles of road.

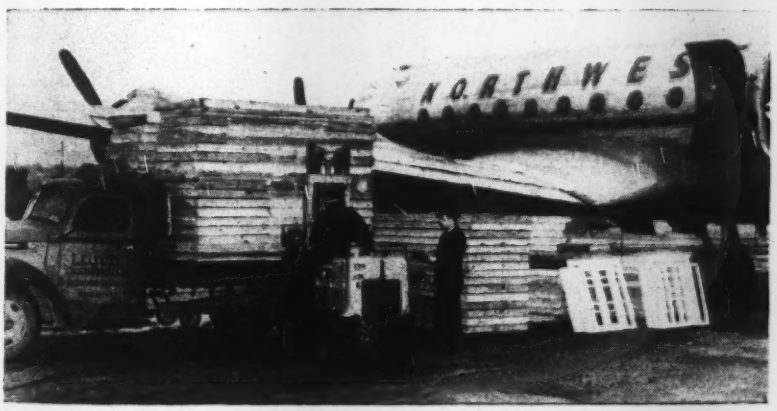
"Many of the large projects placed under contract during the closing months of the year," Mr. Macdonald said, "will not be advanced to the active construction stage until spring.

"The amount of road work placed under contract in 1946 was not controlled by funds that were available for a larger program. Other factors controlled the situation—including unstable economic conditions, scarcity of labor and materials and resulting high contract prices which, in effect, increased the dollar volume but reduced the physical volume of construction."

Kentucky lifts limits on highway truck loads

Making permanent the emergency regulations limiting loading of trucks using state highways, Kentucky last week put into effect a new law raising permitted heights and lengths of trucks, and raising the gross loading limitations to 18,000 lbs. per axle.

The regulations now permit heights of 12½ ft.; lengths of 35 ft. for trucks and 45 ft. for semi-trailers.



***Packaged Housing by Air**—Northwest Airlines is solving a housing shortage faced by its employees at Anchorage, Alaska, by flying in 20 prefabricated houses from Seattle. Valued at $12,000 each, the units weigh 18,500 lb. (including all equipment) and were manufactured by the Williamson Co. of Sheboygan Falls, Wis. Each has six rooms on one floor, with 864 sq. ft. of floor space, and a 12 x 20 ft. garage.*

Buffalo, N. Y., considers downtown parking plans

Using the experience of San Francisco, Calif., as a criterion, city officials of Buffalo, N. Y., are studying proposals for downtown parking facilities, including an underground garage in Lafayette Square.

Henry W. Osborne, traffic adviser to the Buffalo Board of Safety, believes that one such garage will not answer the problem. He pointed out that it would serve only a limited area, and that at rush hours the exodus of cars would cause traffic congestion on streets surrounding the facility.

"We want four such facilities," said Mr. Osborne, "two east of Main St. and two west of Main, north and south of Court St. That would pull traffic off the streets before it gets into the core of trouble."

Favoring multi-deck garages above ground, Mr. Osborne explained the cost is about $700 per stall or car space as against $2,000 to $7,000 per car for the underground facility.

Red Lake highway opened in northwestern Ontario

The Red Lake highway, linking the new mining district of Red Lake in northwestern Ontario with the outside world for the first time by a land transportation route, was opened officially by Roads Minister Doucett recently only six months after work began.

Built at a cost of $3,000,000, the road is 105 miles long, starting at Vermillion Bay on the Trans Canada highway and passing through Quebell on the main transcontinental line of the C.N.R.

The road is in shape to permit its use by winter traffic. The work included 1,325 acres of clearing, close cutting an additional 900 acres, 14,000,000 cu. yd. of earth moving and 250,000 cu yd. of rock excavation, with 250,000 cu. yd. of gravel required for top dressing. Nearly half a mile of timber trestle and bridge structures had to be constructed for the crossing of rivers and streams. The longest bridge is at Trout Lake River—580 ft. long including a 36-ft. truss span.

Freight shipments into the Red Lake mining camp cost, before the opening of the road, $100 per ton by air, $40 per ton by winter transport, and $20 per ton by water transport during the open season. The new road will cut the costs to $5 per ton, thus giving an estimated annual saving of $300,000 on the basis of present freight rates, according to official statements.

Hartford reduces tolls on Charter Oak Bridge

The Hartford, Conn., Bridge Commission announced last week that it had reduced tolls rates for the Charter Oak Bridge at Hartford, by the issuance for sale of 60-trip "commutation" books that will reduce tolls in effect to about 5 cents per crossing. The books will be good for one year.

The commission said the reduction will reduce total revenues, but will still provide enough to meet bond interest and the principal payments on bonds, plus administration, operation and maintenance of the bridge.

Commissioner said increased traffic resulting from completion of new approaches to the bridge and removal of restrictions on use or gasoline dictated the new move.

Closed-shop labor pacts renewed in two states

Representatives of about 3,500 workers in 14 AFL locals, and 153 contractors in Delaware and the eastern shore of Maryland recently renewed for the third time their agreements to operate all building and construction work under closed-shop agreements.

Francis B. McCann, executive vice-president of the Allied Construction Industries of Delaware, and John Turulski, vice-president of the Building and Construction Trades Council of Delaware, signed the one-year contract for their respective groups.

Under terms of the agreement, employers agree to hire workmen who are members of unions belonging to the council. In case of any disagreement, the case is argued before a joint administrative committee.

Seek legislative approval of city manager charters

The Pennsylvania State Chamber of Commerce will ask the state's newly-convened legislature to pass enabling legislation so that the so-called "Home Rule Amendment" ratified for the state constitution in 1922 can become operative and cities may adopt city manager charters.

At present, state law allows only borough and first-class townships to adopt the manager-council system of municipal government. Thirty-six municipalities are now operating under this plan, but chamber officials said that the bill it sponsors will enable other municipalities to take advantage of the constitutional amendment to choose their own forms of government.

Name F. W. Barnes to new engineering post

Frank W. Barnes, for the last several years construction manager for Merritt-Chapman and Scott Corp., has been named assistant to the president of the organization, an announcement said last week.

F. W. Barnes

Mr. Barnes began his association with the construction industry in 1910, and his service includes 15 years as construction superintendent for J. G. White Engineering Corp. of New York City; and vice-presidency of the Parklap Construction Corp. He joined the Merritt-Chapman Scott organization in 1937.

In 1943, he received one of the annual awards of The Moles, New York association of construction men, whose specialty is construction of underground structures.

Western New York towns seek new water sources

Although it failed to recommend government participation in flood-control aspects of the scheme, an Army Engineer's report last week disclosed a possible new source of domestic water for 16 suburban communities surrounding Buffalo, N. Y., and for the area around Lockport, N. Y.

The report was the result of an exhaustive study of Cayuga, Buffalo and Cazenovia creeks, prepared by the Buffalo office of the Corps of Engineers. It concluded that flood control benefits of a dam and reservoir on Buffalo Creek would not warrant government participation, but said that construction of purely water supply reservoirs might produce potable supplies at a lower average cost than the Lake Erie and Niagara River water currently provided.

Award contract for work on Mississippi levee

A $202,000 contract has been awarded to the Kerr Construction Co., of Houston Tex., for developing the special equipment and furnishing all plant, labor and materials for constructing 6,900 linear ft. of impervious cutoff wall and 31,000 cu. yd. of tie-in berm along the left bank of the Mississippi River in the Upper Yazoo Levee District, army engineers said last week.

W. K. Divers made NHA assistant administrator

Appointment of William K. Divers as assistant administrator of the National Housing Agency has been announced by Administrator Raymond M. Foley.

Mr. Divers was formerly special assistant to the Housing Expediter. In that capacity, he worked with home builders organizations and associations, attending many of their regional and local meetings throughout the United States.

Mr. Divers, a native of Cincinnati, Ohio, has had wide experience in housing. In 1939 he was appointed regional director of 15 midwestern states for the United States Housing Authority. In 1941 he became assistant general counsel of the USHA and special assistant to the director of the Division of Defense Housing of the Federal Works Agency.

In 1942, Mr. Divers joined the National Housing Agency as regional representative for Ohio, West Virginia, Michigan and Kentucky. His area was extended later to include Illinois, Indiana, Wisconsin, Minnesota, Iowa, North and South Dakota, Missouri and Nebraska. He served as assistant administrator of the National Housing Agency in 1945 until his appointment as special assistant to the Housing Expediter.

Jefferson Barracks, Mo. to become public park

A large part of the site of Jefferson Barracks, former Army post on the Mississippi River just south of St. Louis, Mo., will become a St. Louis County-owned aviation and recreation center, Presiding Judge Luman F. Matthews of the County Court has announced. He said that government representatives orally have agreed to allow the county to acquire, probably at a nominal cost, 880 acres of the 1231 acres that comprised Jefferson Barracks. It is expected that the transfer of ownership will be completed in a few months in order to permit holding a revival of the St. Louis County fair on the site next August.

Tentative plans for the county-owned project call for a small airport to be designed especially for private planes and to be known as the Jefferson Barracks Memorial Air Park. In addition there is to be a seaplane base on the riverfront and an aeronautical engineering school for war veterans. Recreational features will include a swimming pool and riding stables.

Farm group fights Osceola Dam work

Backing the stand recently taken by their state's governor who charged that construction of the $57,000,000 Osceola Dam on western Missouri's Osage River would be far more costly than probable benefits warranted, a farmers' organization last week asked Congress to withdraw authorization for the structure.

Construction of the dam, which would back up the winding Osage River near its mouth, was authorized in a 1938 flood control act, and was carried in the 1944 act as well. The proposed reservoir would involve purchase of 280,000 acres of land—of which 249,000 acres would be inundated under full reservoir conditions. Construction of the dam would also involve relocation of 40 miles of railroad, 52 miles of federal and state highways, 450 miles of county roads, and many buildings, pipelines, utility lines, and the like.

In a statement issued some weeks ago, Gov. Phil Donelly asked Congress to withhold funds and withdraw authorization on the ground that the entire construction job, at present-day prices, would cost about $100,000,000, and would destroy some 157,000 acres of land for productive use while providing partial protection for about 32,000 acres along the river's course.

Backing this stand, directors of the Missouri Farmers' Association passed a resolution at a recent meeting at Columbia, Mo., also calling for withdrawal of authorization for the dam. Directors of the Association—which claims to represent some 113,000 farmers—agreed that the dam would provide "problematical" return for the relatively large areas taken out of production, and would cause serious tax losses to some 13 western Missouri counties.

Commenting on another phase of federal plans for the Missouri River Basin—a proposed system of levees to control the channel of the Missouri itself—the farmers' spokesmen took the position that it is "unfair" to expect landowners to donate land for the levees when the chief benefits of the levees themselves are also made available to others who do not contribute land.

Disastrous floods occur in Willamette Valley

A recent disastrous flood, the third in four years in Willamette valley of western Oregon, has caused losses estimated by U.S. Army Engineers at $7,500,000. This brings the total flood loss in the area since December, 1942, to more than $21,000,000.

The floods of December, 1942, and January, 1943, also cost valley $7,500,000 and the flood of December, 1945, caused loss of $9,800,000. Losses caused by smaller floods in November, 1942, and 1946, are not included.

Heavy winter rains have made floods almost annual events ever since the valley was settled 100 years ago. Its fertile lands have suffered when the Willamette River, from a source 200 miles south of Portland to the Columbia, and its many tributaries have overflowed.

A change in flood situation is promised when the government's flood control project, started before war and now being continued, is completed. By construction of multiple dams in the Willamette's tributary streams, reservoirs will be created.

Two of dams, one on the coast fork of the Willamette near Cottage Grove and the other on Long Tom River 12 miles northwest of Eugene, were completed before the war. Eleven more are under construction or proposed.

Army Engineers have revised plans for the control of the McKenzie and South Santiam rivers. Instead of two large dams, seven small ones on tributary streams have been recommended. Others under construction or proposed are Detroit Dam on North Santiam, Dorena Dam on Row River and Lookout Point Dam on the middle fork of the Willamette, 20 miles south of Eugene.

LOUISVILLE WATER CO. PAYS DEBT 4 YEARS IN ADVANCE

The Louisville, Ky., Water Co. recently approved not only a $1,300,000 annual dividend to the city sinking fund a month early, but also the payment of all the company's remaining indebtedness nearly four years ahead of time.

Henry M. Gerber, president of the board, said that he was tired of having to say the company is debt-free "except for this odd little amount that stands against us." He referred to the $55,316.10 balance on a one-time $404,000 bond issue that the sinking fund holds for the company. The board voted the payment unanimously.

Final payments on the bonds, which were issued in two groups, 1906 and 1910, were not due until Aug. 1, 1950. As the bonds cannot be called, interest to maturity is included in this payment.

Philadelphia earmarks $90 million for building

Seeking to expedite a $302,000,000 postwar reconstruction and rehabilitation program recommended recently by its planning commission (*ENR* Dec. 5, 1946, vol.p. 765) the City of Philadelphia, Pa., has appropriated a total of $90,000,000 to finance initial stages of the work.

Mayor Bernard Samuel said last week that plans have been completed for work to cost at least $25,000,000, and that financing is now assured for several years of work. Top-priority projects include: improvements in the sewage treatment system; rehabilitation of the water works; expansion of the municipal airports; highway improvements, and other work.

Concurrently with Mayor Samuel's announcement, the Philadelphia Board of Public Education announced it had authorized and sold a $5,000,000 bond issue to complete financing of a contemplated $10,000,000 building program. A previous $5,000,000 issue was sold a year ago.

Big budget requests for Indiana state buildings

The Indiana State Budget Committee is studying requests from state institutions for appropriations to be made by the 1947 legislature, including the following construction:

Indiana State School for the Deaf, Indianapolis, $1,184,500 for building and repairs; Fort Wayne State School, Ft. Wayne, $1,480,000 for new structures and repairs; Muscatatuck School, $678,700; Silvercrest Sanitarium, New Albany, $479,000 for new facilities; Central State Hospital, Indianapolis, $1,100,000 for receiving unit; $1,054,000 for new cottages for patients; $547,000 for general stores building, and $287,000 for general repairs; Longcliff Hospital, Logansport, $1,800,000; Richmond State Hospital, $1,600,000 for new buildings and improvements and $700,000 for additions at the epileptic village.

Purdue University, Lafayette, $2,000,000 for completion of present chemistry building, $2,000,000 for a science building, $1,000,000 for an engineering building, $1,250,000 for library addition; $1,500,000 for improvements at the university airport.

Indiana University, Bloomington, $2,400,000 for a new library; $2,250,000 for a life science building; $1,350,000 for the first unit of a new power plant, and $850,000 for a new classroom building and facilities.

ENGINEERING SCHOOL NEWS

Iowa revises engineering course—Case to change its name—Research at Lehigh—Minnesota summer school

New entrance requirements and a general revision of the entire engineering course have been announced by Dean F. M. Dawson of the college of engineering of the State University of Iowa, Iowa City.

The new engineering requirements, affecting all students entering after June 1, 1947, will permit an expansion in social science and the humanities during the 4-year engineering course. This trend is in accordance with the recommendations of the American Society for Engineering Education.

Beginning in June, freshmen entering the college of engineering will be required to present two semester hours of credit (or its equivalent) in college algebra, two hours in trigonometry, four hours in English composition and speech, and four hours in inorganic chemistry. This means that most entering students will require at least one semester of work in a liberal arts or junior college in addition to graduation from high school.

The new engineering course will include a total of about 25 hours of work in humanities and other non-technical fields. Courses now planned are in English, speech, history of engineering, technical writing, economics, political and social science, and certain other approved electives.

Case School of Applied Science, Cleveland, Ohio, will become the Case Institute of Technology early this year, provided a petition filed Dec. 30 in Common Pleas Court by Frank A. Quail, president of the college's trustees, is approved. The court's permission is necessary since changing the name departs from the provisions made by the founder, Leonard Case, Jr., in a trust established in 1877. No opposition is expected to changing the name.

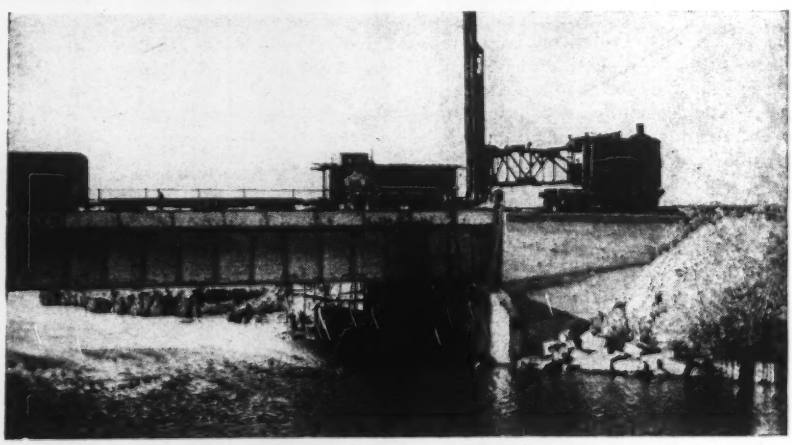
The creation of a school of architecture and landscape design at North Carolina State College, Raleigh, N. C., has been authorized by the trustees of the Greater University of North Carolina, and it is expected the school will be in operation by next July. At present instruction in those subjects is supervised by the school of engineering.

Lehigh University has received a grant of $60,000 from the War Department to make an engineering analysis of bomb damage reports and studies made in World War II. The research project announced recently by Harvey A. Neville, director of the Institute of Research at Lehigh, will be directed by Cyril D. Jensen, professor of civil engineering. Assisting him are other Lehigh faculty members including Merton O. Fuller, associate professor of civil engineering. The Carter Oil Co., Tulsa, Okla., has presented to the university an improved Truman gravity meter. This instrument, considered ideal for undergraduate instruction and graduate research, will be used by the geology, mining, and physics departments in measuring differences in gravity between two given points, to determine sub- surface geological structure, and to determine micro seisms.

A proposal to hold the summer surveying camp at Rosemount, Minn., has been presented to the University of Minnesota administration by the civil engineering department. The 1947 summer camp will be about twice the size of any previous one, with an anticipated enrollment of 120 men. The camp period follows the junior year. For 1947, a 4-week session is planned. Prior to the war, summer camp was held at Cass Lake, Minn., and lasted six weeks. Facilities there would require extensive additions to accommodate the heavy enrollment, hence the proposal to use Rosemount since the War Assets Administration has approved transfer of a major portion of Gopher Ordnance works there to the University of Minnesota for educational purposes.

The eighth annual highway conference of the department of civil engineering of the University of Utah will be held at the university, Salt Lake City, March 3-5.

Arrangements are being made by the State Sanitary Water Board with Pennsylvania State College to conduct research into a method of treating wastes which is practical for the smaller slaughter houses throughout the state, Dr. Harry W. Weest, health secretary and board chairman, has announced. The research program is in furtherance of the vast "Clean Streams" drive of the board to control pollution of the waterways. This research program will be the third arranged by the Sanitary Water Board in the current drive. A few months ago the board arranged with Mellon Institute, Pittsburgh, to conduct research into the formation of acid and acid compound in coal mines which cause an acid condition of the streams. Efforts are being made to find practical methods of treatment to reduce or prevent stream pollution by acid mine wastes.



***Temporary Pier Built Through Bridge**—First step in rebuilding the abutment for the Canadian National Railways 4-track main line over the Humber River in Toronto was construction of a temporary pier. Since the bridge also carries Canadian Pacific RR traffic, only one track at a time can be taken out of service. Steel H-piles, driven through the bridge inside a sheet-pile cofferdam are surrounded by aggregates vibrated to completely fill the cofferdam. Cement grout then is intruded into the aggregate, without dewatering, to make a concrete pier. The eastern abutment of the bridge has shown serious signs of weakness, caused probably by scour, and a point of partial failure may be noted beneath the ladder in right center.*

OBITUARY

Herbert Shelton Ragland, 58, engineer and architect who rendered archaeological and historical service in connection with the $15,000,000 John D. Rockefeller Jr. restoration of Williamsburg, Colonial capital of Virginia, died Dec. 31 in Richmond, Va. Mr. Ragland was for a number of years a member of the firm of W. L. Ragland & Son, Richmond contractors and builders. He was chief engineer of the town of Barton Heights at the time Richmond's city limits were greatly expanded by annexation in 1914. The town then became a part of the city. In World War I Mr. Ragland served in France as a member of Company B, 6th Engineers, United States Army, Third Division.

Collins P. Bliss, 80, Scarsdale, N. Y., retired dean of the college of engineering, New York University, died while visiting at Tupper Lake, N. Y., Dec. 27. Mr. Bliss was a graduate of Princeton University, 1888. He received his master's degree from Columbia in 1891. At the time of his retirement in October, 1936, after 40 years of teaching at New York University, he received an honorary degree of Doctor of Engineering from Stevens Institute.

Frederick C. Noble, 74, of Fairfield, Conn., retired civil engineer, died at St. Petersburg, Fla., Dec. 17. He was in the service of the City of New York from 1900 to 1914 on bridge, subway and tunnel work. He was division engineer for construction of the first rapid transit tunnel under the East River.

Isaac C. Cowie, 71, long time general contractor in Ottawa, Ont., died Dec. 27.

John Vance Poole, 86, a former civil engineer and once a state senator in Kentucky, died at Cairo, Ky., Dec. 12.

Donald S. Birkett, 63, civil engineer, died at Miami, Fla., Dec. 20.

W. Rathbone Smith, 67, formerly with the engineering department of Alexandria, Va., died there Dec. 22. A native of Pembroke, Ont. Mr. Smith had devoted most of his early life to railroad construction and engineering in northwestern Canada. He joined the city engineering department in 1934 as assistant superintendent of PWA work for Alexandria and later worked in the building inspector's office until his retirement six years ago.

Clinton Inglee 60, president and general manager of the National Water Main Cleaning Co. of New York City, died at Amityville, N. Y., on Dec. 21. A graduate of Stevens Institute of Technology, 1908, he entered the employ of the company which he served as engineer, secretary, treasurer and general manager before becoming president. Mr. Inglee took an active part in the work of the Water and Sewage Works Manufacturers Association, of which he was president in 1938. He was also active in the American Water Works Association. At the time of his death he was a member of its general policy committee, representing the manufacturers' group.

Benjamin Weiss, 60, an engineer of the Queens Borough president's office, N. Y. City, died at Emporia, Va., Dec. 30. With a civil engineering degree from Columbia, he began as a civil engineer with that office 39 years ago and had served as chief of the Queens topographical bureau and as a representative on the Board of Estimate. He also had been editor of "The Municipal Engineers' Journal of the City of New York."

Walter Sheldon Rodman, 63, dean of the engineering school of the University of Virginia since 1933 and a member of the faculty for 36 years, died at Charlottesville, Va., Dec. 31. He received his education at Rhode Island State College, Kingston, R. I., where he later taught, and at the Massachusetts Institute of Technology.

Gerald T. McCormick, 50, senior engineer of the Milwaukee, Wis., Water Department, Construction Division, died Dec. 13.

MAJOR MEETINGS

American Society of Civil Engineers, annual meeting, Commodore Hotel, New York, N. Y., Jan. 15-18.

Associated General Contractors, annual convention, Stevens Hotel, Chicago, Ill., Jan. 27-30.

National Crushed Stone Association, annual meeting, Edgewater Beach Hotel, Chicago, Ill., Jan. 27-29.

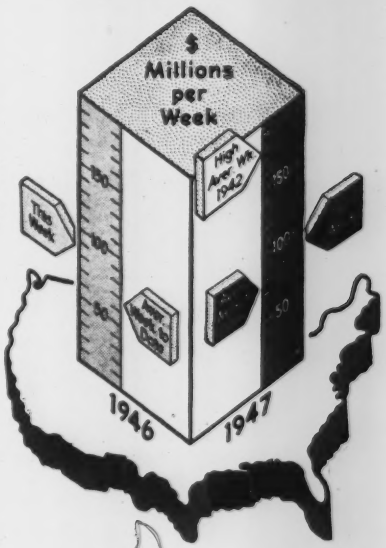
Associated Equipment Distributors, 28th annual meeting, Edgewater Beach Hotel, Chicago, Ill., Feb. 13-15, 1947.

American Concrete Pipe Association, annual national convention, Statler Hotel, St. Louis, Mo., Feb. 23-25.

American Concrete Institute, 43rd annual convention, Cincinnati, Ohio, Feb. 24-26.

American Society for Testing Materials, Committee Week, Benjamin Franklin Hotel, Philadelphia, Pa., Feb. 24-28.

CONSTRUCTION ACTIVITY



As Reported this week to . . . *Engineering News-Record*

CONTRACT VOLUME

Continental U. S. Only (Thousands of Dollars)

	Week of Jan. 9 1947	Cumulative 1947 (2 wks.)	Cumulative 1946 (2 wks.)
Federal	$9,238	$14,822	$9,678
State & Mun.	26,736	50,860	31,308
Total Public.	$35,974	$65,682	$40,986
Total Private	54,459	86,659	90,280
U. S. Total..	$90,433	$152,341	$131,266

WHERE CONSTRUCTION ACTIVITY ORIGINATED THIS WEEK

Dollar Volume (Thousands)

Type of Work	This Week	Cumulative 1947 (2 wks.)	Cumulative 1946 (2 wks.)
Waterworks	$1,771	$10,461	$705
Sewerage	1,718	4,282	1,597
Bridges	2,640	3,658	5,049
Highways	7,377	13,626	13,494
Earthwork, Waterways	3,071	3,959	3,280
Buildings, Public.	7,642	13,276	13,134
Industrial	11,246	18,088	32,524
Commercial	41,379	64,011	53,514
Unclassified	13,589	20,980	7,969

NOTE: Minimum size projects included are: Waterworks and waterway projects, $22,500; other public works, $40,000; industrial buildings, $55,000; other buildings, $205,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1947 (2 wks.)	Cumulative 1946 (2 wks.)
NON-FEDERAL	$15,483	$42,462
Corporate Securities	1,225	33,311
State and Municipal	14,258	9,151
FEDERAL	.....	158,320
Total Capital	$15,483	$200,782

ENR INDEX NUMBERS

Index Base = 100		1913	1926
Construction Cost...	Jan. '47	381.68	183.47
Building Cost.....	Jan. '47	288.78	156.11
Volume	Dec. '46	207	91

EDITORIALS

VOLUME 138 NUMBER 2

January 9, 1947

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It Could Be A Happy New Year

WITHOUT ARGUMENT or analysis, but merely as a matter of interest, we offer a number of significant facts: Despite difficulties, 1946 construction reached a large total. Supplies of building materials are approaching adequacy. Construction costs moved up only slightly after price and wage controls were removed. Work stoppages are becoming unpopular with the workmen. Labor efficiency is improving. Many government controls are relaxed. Employment is high among engineers and construction men. The demand for every class of construction remains insistent. The net result could mean a Happy New Year, which we sincerely wish for each and every reader.

Construction in 1947

DIZZINESS, brought on by extra large doses of statistics, is a malady normal to the New Year. To avoid it, readers sometimes, and understandably, merely see the headlines and skip the explanation, but, as regards estimates for 1947 construction at least, such scanning could lead to erroneous conclusions. For example, the U. S. Department of Commerce recently made a prophesy of $22 billion. If this is accepted without examining the Commerce Department's explanation, other estimates of $12 to $15 billion seem far out of line. Actually the $22 billion estimate includes $6 billion of maintenance and repairs, not usually included in other estimates. For new construction, therefore, the Commerce estimate is $16 billion. But unlike most other statistics, which are based on contracts awarded, the Department of Commerce figures represent "construction in place". Thus, those parts of 1946 jobs, uncompleted in 1946, will swell the Department of Commerce 1947 total. The Asociated General Contractors estimate the 1946 carryover into 1947 at around $5 billion. This brings the Commerce total down to $11 billion of new construction in 1947, which is in the range of other estimates, but is still not comparable because it represents only completed construction and not contracts awarded. On the latter basis the total would be larger, and this journal has estimated it at $12 billion, about a 20 percent increase over 1946. Other estimates are in the same neighborhood. The Department of Commerce figures are not wrong or inflated. They merely cover more and different things, which are readily apparent upon examination. But no matter how measured, construction is big business. And 1947 promises to prove it.

Bidding back to normal?

AT LEAST ONE CITY may have turned the corner on the uncertain road to normal bidding for its public works projects. On Dec. 16, Chicago received seven bids for the $300,000 job of building the substructure for the 130th St. bridge across the Calumet River. Two of the bids were within the engineers' estimate, which was realistic but not extravagant in its appraisal of present-day costs. One of the bidders is a large contracting firm which has not for years submitted a tender for any of the city's advertised projects. Keen competition for this job may be merely an isolated instance of a change in thinking on the part of a few contractors, or it may presage a healthy return to normal bidding conditions. When viewed in combination with another project, a difficult viaduct repair job for which the city was somewhat surprised to receive two sharply competitive bids, it seems, however, to point to a resumption of vigorous bidding.

Better Joints in Sewers

JOINTS IN LARGE SEWER PIPE have received less than their rightful share of attention because frequently, as in the case of storm or combined sewers, it is unimportant whether or not the joints are absolutely tight. But the time comes, as it did at Tacoma, when tight joints in a trunk sewer become vitally necessary. Then it is discovered how little precedent there is in really high-quality sewer jointing practice. Mortar, asphalt and even oakum have been used in such joints with varying success and durability. In all of the usual joints the human equation is a factor. Moreover, taking sufficient care to insure a perfectly watertight joint may

make the cost prohibitive. The requirement on the sewer job now under way at Tacoma was for joints at once "waterproof, foolproof and not too costly." No precedent for such joints was found but just then "fortune smiled," as Tacoma's sewer engineer puts it, in the opportune invention of a small, effective pressure grouting machine as described in this issue. With this outfit, the requirements are being met and perhaps a precedent is being set. Certainly there has been room for improvement in sewer jointing practice.

Bidding for Engineering Services

RECENT EVENTS have again called attention to the fact that although bidding for engineering engagements is frowned upon by all major professional organizations, it is practiced, in one form or another, with growing frequency. Some engineers bid openly; others seek to get into the running by means short of submitting a sealed bid that must be publicly opened. This is an unhealthy situation calling for action by professional groups, presumably under the leadership of the American Society of Civil Engineers, which for nearly a century has led drives for higher professional standards.

Action on this matter of bidding for professional engagements, however, should not simply take the form of discipline for consultants who have had the courage to do openly what some of their fellows have done covertly in the past. What is needed is an uninhibited analysis of the present rules of the game in the light of current conditions to determine whether a change is indicated. The study must include a review of codes of ethics and practice.

An analysis of this kind must frankly face the fact that theory and practice with respect to securing professional services have been far apart for many years. In theory, consultants do not compete with each other on a price basis; in practice the competition is keen, and on occasions has been of a very low order. In the past, men who have stood high in the civil engineering profession have not hesitated to use political influence to land attractive jobs. Devious channels are followed by some consultants to learn the amount for which other consultants have offered to do a particular job in order that their proposals may not be too far out of line.

Not to be overlooked is the possibility that some of the practices that have been outlawed by engineers—and doctors and lawyers too—may have been outlawed in fear of competition. Thus, schedules of fees for professional services—which serve the very useful purpose of informing the uninitiated as to what engineering services should cost—are set up as measures of ethical standards by codes of practice that make it unethical to cut fees below those given in the schedule. Such an arrangement gives the individual or firm with a recognized standing a distinct advantage over the relatively unknown but possibly equally able engineer who is willing to work for little or no profit to get established in business. There is nothing unsound in this latter practice so long as the client is *adequately served.*

The standard explanation of why professional societies bar competitive bidding is because a dollar value cannot be put on professional services. Yet the fact remains that every engineer, doctor and lawyer in private practice does put a dollar value on his services, for each sets the fee for which he will perform the service required of him.

While it is true that bidding for professional engagements has its disadvantages, there is little to label it fundamentally wrong. On public work, which is where all the issues with respect to bidding for engineering engagements have arisen, arguments can be made in favor of such bidding. In the first place, it is the accepted way in which municipalities engage other kinds of services, and it is the legally prescribed way in which all services have to be engaged in some municipalities. Also, a publicly advertised call for bids gives the municipality a greater range of talent and keener competition, which is a fundamental of the American economic system.

Not to be overlooked is the fact that the present system does not keep unqualified men from securing jobs. In contrast, it might be possible to set up a system for bidding for professional services that would give the public a greater measure of protection against incompetent practitioners than it has today.

These are some of the factors that need to be considered. And the defects of the present system are serious enough that such consideration should not be long delayed.

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Fig. 1. Half span of Pont Gallieni being raised with jacks, A-frames and hand winches.

Lyon Rebuilds Its Many Wrecked Bridges

***Contents in Brief**—Famous French industrial city, Lyon, lost 22 of its 24 bridges in the last days of war, but a great coordinated effort of government and construction forces put most of them back on a temporary basis, and now permanent rebuilding is under way. Notable jobs have included the construction of a 160-ft. masonry arch on hung falsework and the raising of a severed 206-ft. steel arch with jacks.*

THIRD CITY OF FRANCE in population, Lyon, cut into three parts by the Rhône and Saône rivers, probably ranks first as a city of bridges. As a consequence, it also stands at the top in war damage to its bridges, 22 of its 24 river crossings having been wrecked in the last days of the war. In a paper written for the Institut Technique du Batiment et des Travaux Publics, Andre Mook-Aray, Chef du Service Special de Reconstruction des Ponts de Lyon, describes the extensive temporary reconstruction that was immediately undertaken to restore cross-river traffic, and the permanent rebuilding that is now under way or completed. This article is based on that paper and is illustrated with photos and drawings furnished by Mr. Mook-Aray.

Immediately after the liberation, American Army Engineers launched a 100-ft. military bridge across the destroyed stone arches of the Pont Guillotière, but it was not until five weeks later that civil authorities were able to supplement this with another temporary crossing and five footbridges so that reasonable circulation of traffic was possible. Today, after 18 months, the situation is normal, insofar as traffic on temporary structures is concerned, and three large bridges have been restored permanently. These include two steel arches, the Pont Mulatière over the Saône and the Pont Gallièni over the Rhône, and the masonry arch, Pont Wilson, also over the Rhône. In addition, work is under way to replace the old Kitchener suspension bridge with an entirely new bridge to serve one of the principal north-south highways of France.

Forces organized for rebuilding

In total, the openings in the wrecked bridges of Lyon (Fig. 2) were reduced from 6,500 ft. in September, 1944, to 1,450 ft. in March, 1946, reflecting the placing in service of 10 highway bridges and 8 footbridges. These results were attained by organizing a pool of all engineering and construction facilities in the city, including municipal engineers, fabricators, contractors, trade unions and trucking companies, and putting it to work under the coordinating hand of the Services des Ponts et Chaussées, with Mr. Mook-Aray in charge.

In the reconstruction work extensive use was made of hung centering to aid in the restoration of masonry, one early example being on the Pont Guillotière where the centering was supported by the Bailey bridge that the American army had installed across the opening. On two temporary structures, Pont Tilsitt and Pont Morand, entirely new piers were built. Pigeaud-type military bridge trusses were placed on the former, and steel I-beams on the latter. The Pont Morand, containing sixty-six 60-ft. beams in eleven spans 36 ft. wide, was built in 50 days.

One of the most interesting temporary repair jobs was carried out on the Pont Mulatière, a deck cantilever from which the central suspended span had been blasted away, leaving the cantilever arms and anchor spans intact. Always short of

aterials, the Lyon engineers in this ase resorted to the use of tubular etal scaffolding, (Fig. 3) assembling it into a "truss" that was launched across the opening to restore half the original roadway width. The joints of the scaffolding assembly were made by the usual clamped collars, although in the areas of max-

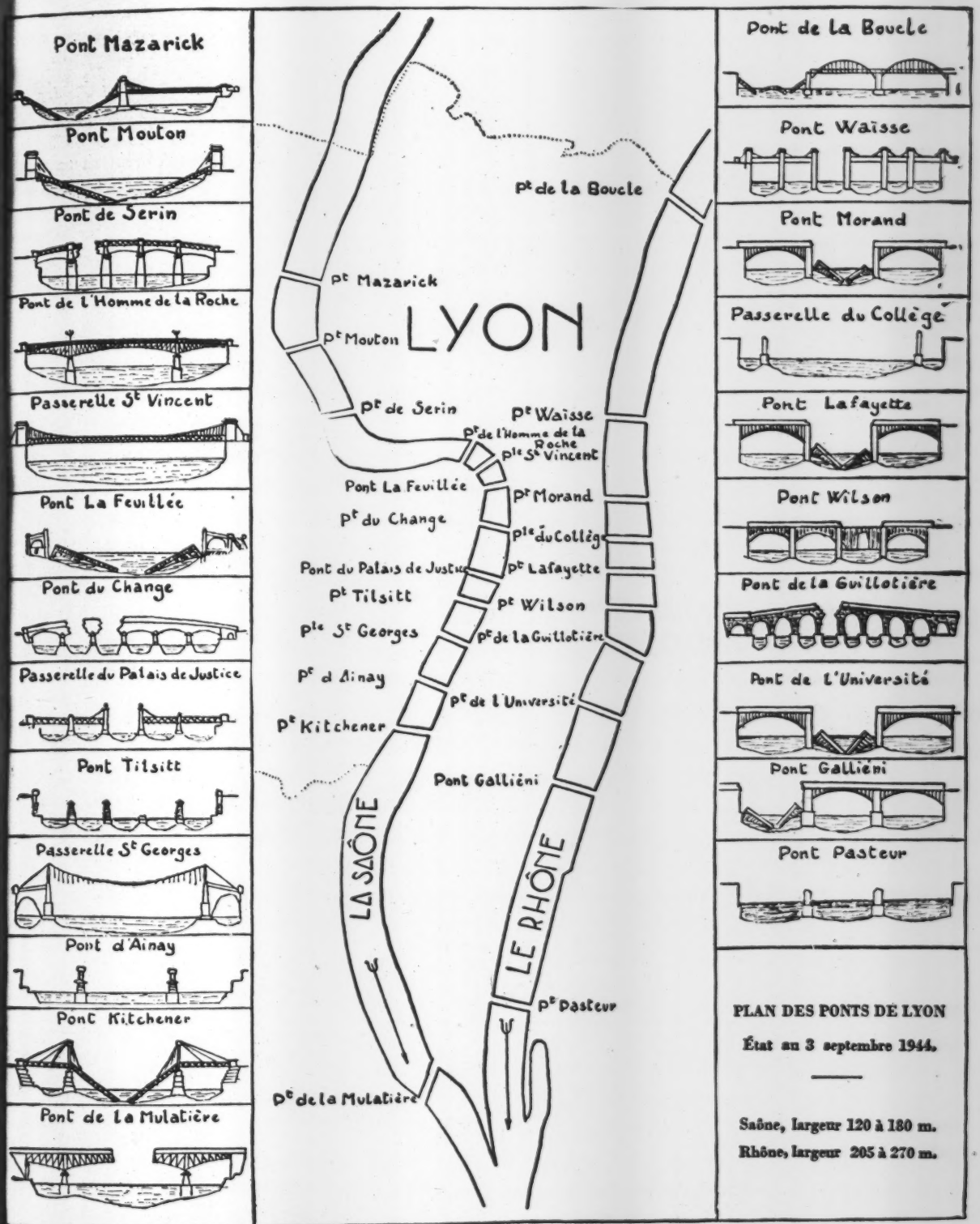


Fig. 2. Map and sketches showing condition of bridges of Lyon, France, in September, 1944. Reproduced from Mr. Mookray's original paper. Of the 24 bridges, 22 were wrecked during the war.

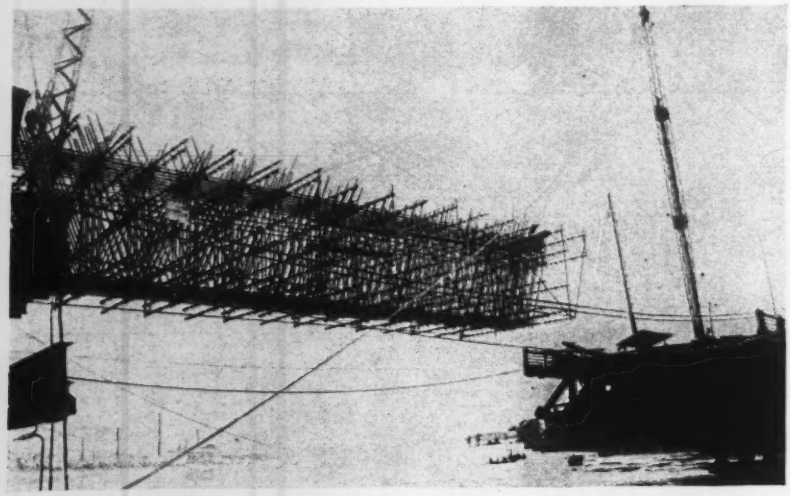
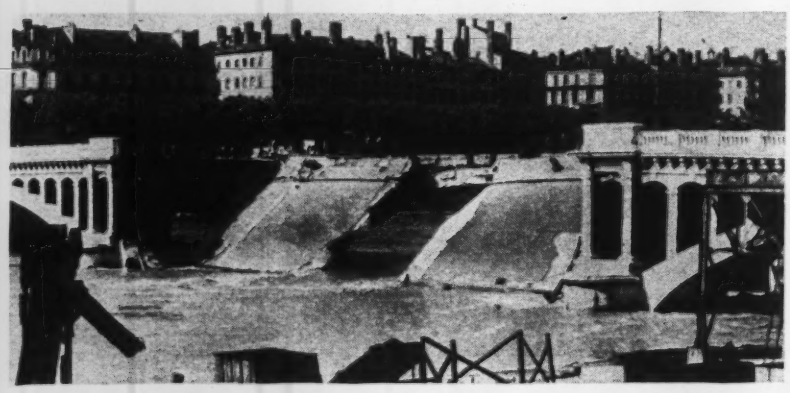


Fig. 3. Temporary truss, assembled from tubular metal scaffolding members, being launched across the opening in the Pont Mulatière. Of half-deck width, this served traffic while permanent reconstruction was carried out on other half of deck. Wrecked steelwork was removed from river and restored to service.



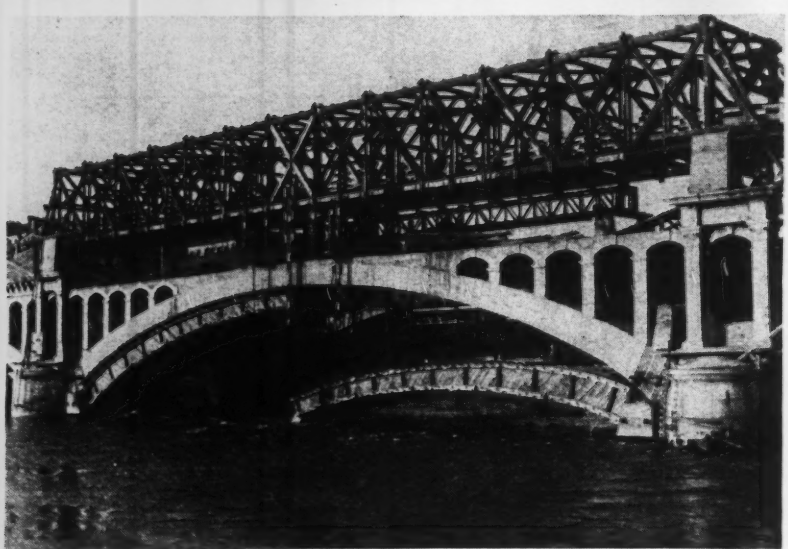


Fig. 4. Pont Wilson, as it was damaged (top) and as it was rebuilt. In lower view, centering hung from the timber truss is being removed after the downstream stone masonry rib was completed.

imum stress these were supplemented by welded metal rings.

While this temporary crossing was in service, the wrecked steelwork was removed from the river, and as much of it as possible was sent to the shop for renovation. Then the repaired steel (113 tons), along with necessary new members (102 tons), was re-erected in the half width of the bridge roadway that had been left open. A cableway was used for the erection to eliminate the necessity for falsework, which would have been vulnerable to the floods that constituted one of the principal difficulties for all of the repair work carried out in the fall of 1944. When half of the original bridge had been replaced, the tubular scaffolding span in the other half was merely lowered onto barges, and the final repairs completed.

Rebuilding a masonry span

Unlike the Pont Mulatière, the Pont Wilson, a 4-span monumental stone arch, could not be reconstructed with any of its damaged material. One of the 160-ft. spans had been demolished by explosive charges placed on the deck, and while this severed only the downstrean rib of the two lines of 16-ft. wide arch ribs, leaving large deck sections sloping into the river from the upstream rib, (Fig. 4) the destruction was so great as to require complete rebuilding with new material of all parts except the one undamaged rib. Moreover, it was not possible, with the means at hand, to remove the debris from the river bed so that a method of construction without falsework was mandatory.

The reconstruction plan adopted was to launch a 170-ft. timber truss bridge across the opening, from which the arch centering for the new rib could be hung until it was assembled and self-supporting. Then, disconnected from the centering, the timber bridge served as a support for a traveling crane with which the masonry was placed. Finally, it was converted to a pedestrian crossing during the time that the upstream arch was being repaired and the deck completed.

Because of the scarcity of bridge timbers, both the truss bridge and the arch centering were built of nailed planks (Fig. 4). The centering consisted of four box girder ribs.

each 34 in. wide and 24 in. high, assembled side by side, with X-bracing between, to provide a platform 16.5 ft. wide. The webs of each centering rib were made up of two layers of planks inclined at 45 and 135 deg. while each flange contained thirty-two 9x1-in. planks set vertically in a laminated assembly. This type of construction proved safe and satisfactory to carry the first ring of stone weighing about 420 tons.

The most interesting part of the job involved the construction of corbels at the piers to support the ends of the arch centering. Since it was not possible to drive falsework, a scheme was devised whereby the corbels would be supported partly by the small remaining part of the original arch skewback and partly by a set of 1 in. dia. adjustable rods carried in hairpin fashion over a reinforced concrete beam set in the masonry above the pier. Since the corbel was only a few feet above the normal water level in the Rhône, in order to avoid delays by floods it was decided to precast the corbel in the form of a box or cofferdam, (Fig. 5) lower this to position, support it by the 1-in. rods and fill it with concrete. This corbel then provided a reaction for the arch centering on which the stone masonry arch could be built.

While the new arch rib was being built, cracks in the downstream rib were repaired, and in addition the concrete floorbeams, that carried the deck between the two ribs were precast on shore. Much time was thus saved in final completion of the new span.

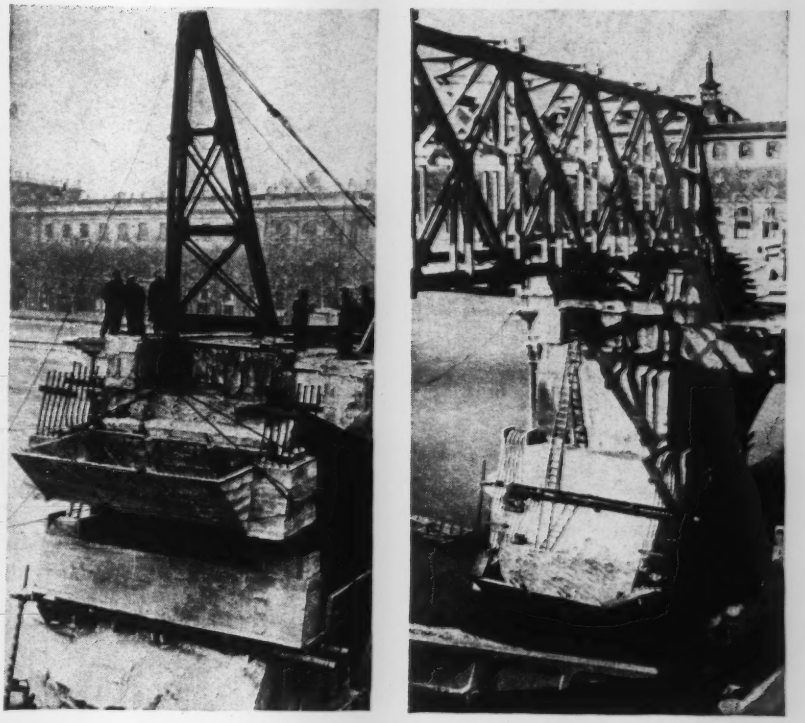


Fig. 5. Constructing the corbels for support of the ends of the arch centering. Precast in the form of a concrete box, the corbel was lowered to the water surface (left), where it was suspended from adjustable steel rods (right) and filled with concrete. These corbels may also be seen in the lower view of Fig. 4.

Raising steel arches

Four similar steel arch bridges over the Rhône,—Morand, Lafayette, University and Gallièni,—each about 650 ft. long and 65 ft. wide, and divided into three deck spans, were damaged in the same way—by charges placed on the deck of one of the spans, which broke it in the center, while the ends remained attached to their hinge pins. Suffering similar destruction, each of the spans was repaired in the same way, the operations on the Pont Gallièni (Fig. 1) being typical of those carried out on all four structures.

In falling, the Gallièni span came to rest with the broken ends still partly connected. Since blasting them apart would have caused extra, undesirable damage, it was decided to raise the whole span as a unit until it was free of the water, and then to cut out the damaged parts before lifting it, in two halves, to its level position. Although difficult, this procedure had the advantage of setting up forces at the center of the span which would push the two ends back to their original positions on their supports. The total weight to be handled was about 800 tons.

Four sets of lifting apparatus were used. At the abutment, where work could be carried out on the river bank, wedges mounted on rollers were placed under each of the eight arch ribs. On the pier, at the other end of the span, four 7-ton hand winches were mounted, their cables running over steel A-frames to connections on the arch ribs at the first vertical forward of the hinge. And at each of the third points of the span, eight 50-ton jacks were installed, one over each arch rib. The jacks were mounted on a pair of steel reaction beams set transversely on steel towers in turn resting on timber bents, the piles for which were driven through holes in the bridge deck. Each jack was connected to its arch rib through a steel plate yoke equipped with holes that could be pinned off as raising proceeded. These yokes had negligible rigidity in a direction lengthwise of the bridge, so as not to resist any longitudinal translation of the structure.

All of this lifting apparatus was operated simultaneously, six men on each winch, two on each jack and sixteen at the wedges. After the span was clear of the water it was cut in two, and the two halves raised separately. The jacking arrangement is illustrated in Fig. 1, which shows the left half of the span raised, while on the right half the equipment is being assembled prior to raising; the second of the jack reaction beams is about to be raised to the top of the steel towers.

Once in final position, the bridge was cleared of equipment, new material was installed at the break, a new roadway placed, and the structure put back in service. The entire operation consumed nine months and cost 9,800,000 francs, about $85,000.

Virginia Selects Broom Drag Treatment For Repair of Primary Road

***Contents in Brief**—On repair of a primary highway in Virginia a broom drag treatment permitted a section to be completed each day and the road kept open to traffic. The procedure used required only one passage of the drag, which was followed by a single passage of a planer. The cost compared favorably with other repair methods studied.*

To bring a 2.8-mi. section of U. S. Route 460 at the western edge of Lynchburg, Va., into first class condition, the Virginia Department of Highways has used a broom drag surface treatment considered to offer advantages for repairing a heavily traveled road that must be kept open to traffic. Although the procedure is similar to that employed previously in North Carolina, it is somewhat different from past operations in Virginia and the cost of the work compares favorably with older methods.

Route 460 is a heavily-traveled primary highway and three 10-ft. lanes are provided west of Lynchburg. The old pavement was an 8-in. water-bound macadam constructed a couple of decades ago and for several years maintained by surface treatment methods. In 1937 a cold-laid asphaltic concrete top was put down and in 1944 the surface of the pavement was sealed by application of 0.15 gal. per sq. yds of RC-2 asphalt and about 10 lb. per sq. yd. of crushed stone.

Damaged by heavy traffic

During the war years the pavement was damaged appreciably under the heavy traffic carried by the road, including a high percentage of trucks, and this year addition of a new wearing course was considered necessary. Not only were good results at reasonable cost desired, but the method used had to permit traffic to continue to use the road with a minimum of interference. Application of a seal coat and stone chips was considered as a possible repair method, as was construction of a mixed-in-place top put down by standard methods. However, experience in topping 15 to 20 miles of road in 1944 with the method to be described, and another 40 miles in 1945, proved that the procedure selected offered major advantages and should be used.

Tighter surface obtained

These advantages included the fact that the broom drag treatment would result in a much tighter top than would be possible with a seal coat and stone chips, although the cost would be only about 20 percent more. Also, the broom drag treatment was expected to result in less difficulty with the asphaltic materials emulsifying in case of rain than with a straight seal treatment.

The major advantages of the drag treatment over standard mixed-in-place methods is the fact that with the latter method about 60 lb. of stone per sq. yd. must be added or much more than with the procedure selected, which makes the drag treatment considerably cheaper. Moreover, with the drag treatment, a section of the roadway could be repaired much quicker than with the usual mixed-in-place methods. On the heavily traveled road being repaired this latter factor was of considerable importance.

The final decision was to apply a broom drag treatment one lane at a time, with one of the outer lanes repaired first, next the center lane, and finally the remaining outer lane. At all times traffic was permitted to use the two lanes not being repaired. Flagmen and warning signals were employed to reduce the speed of the traffic sufficiently so that the workmen and their equipment were not in danger.

As a first operation in repairing a given lane, a tack coat of 0.10 gal. of RC-2 asphalt was applied at a temperature of 125 deg. F. by a 750-gal. distributor. As soon as possible 35 lb. per sq. yd. of stone chips were added by spreader box with the truck operating in reverse to permit the vehicle to travel on the freshly placed stone.

On one part of the project, granite chips were used for the aggregate and on the remainder crushed dolomite. Both types of stone had to meet the following sieve analysis:

Sieve Size	Percent Passing
½-in.	95 to 100
No. 50	25 to 50
No. 8	0 to 10

Because the stone had to be stored near the job in open stockpiles, it contained considerable moisture as first spread on the highway. However, because of the hot summer temperature at the time the work was done, plus the fact that the material was spread out uniformly in a thin layer, the moisture content was reduced rapidly, enough so that in a few hours the mixing asphalt could be added. The fact that the stone could be dried in this manner, plus the color contrast between the fresnly added stone and the other lanes, which tended to keep traffic off the lane being repaired, resulted in decided advantages in the process being described.

Asphalt application varied

For the outer lanes, spreading of the stone was followed by application of 0.25 gal. per sq. yd. of RC-2 asphalt added with the distributor previously mentioned. On the center lane the amount of asphalt was increased to 0.30 gal., as less traffic is expected to use this lane and therefore compaction under traffic will be less and a higher asphalt content was considered necessary to provide the tight surface desired.

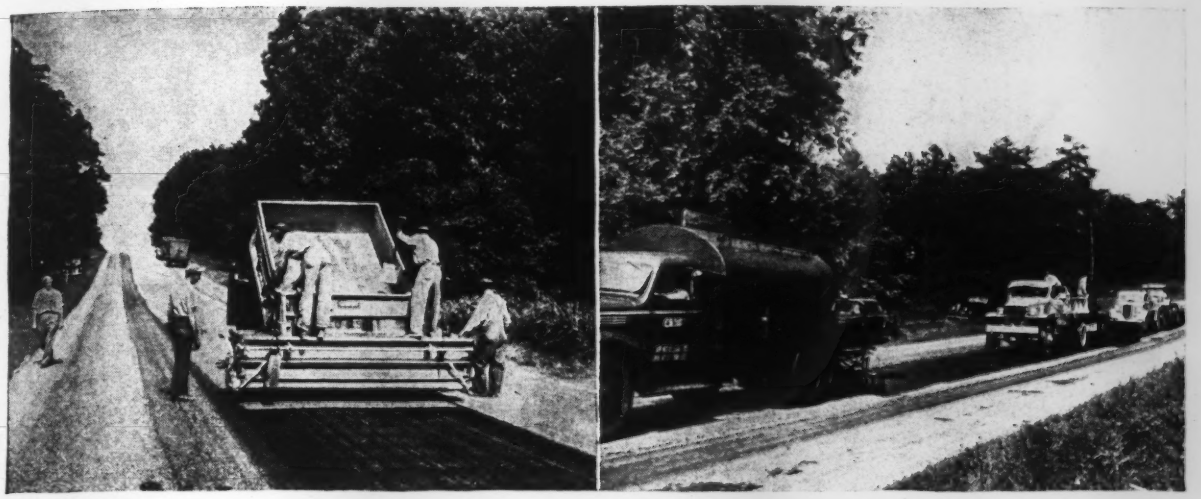


Fig. 1. Following application of an RC-2 tack coat, 35 lb. per sq. yd. of crushed stone was added (left). Once the stone was dry, the RC-2 mixing asphalt was added, followed immediately by a broom drag and a planer (right).

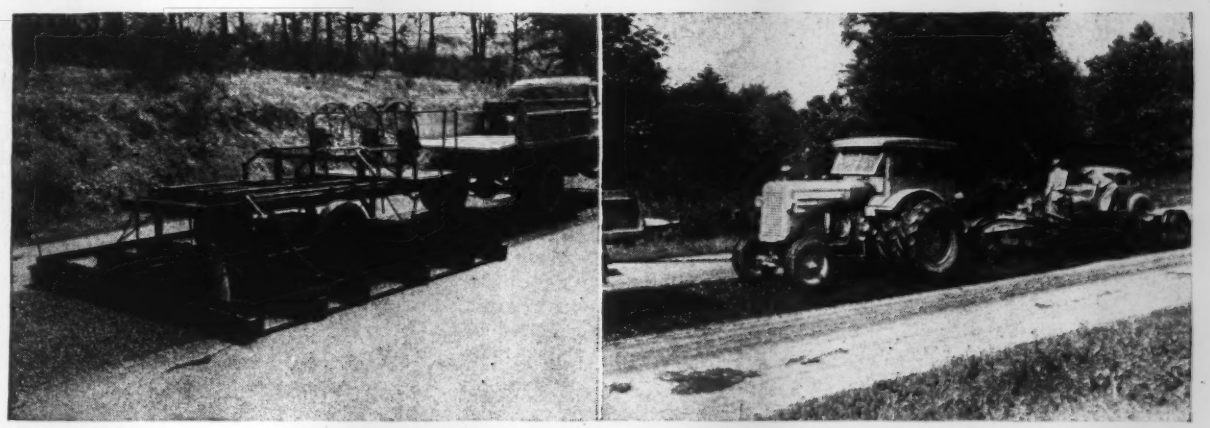


Fig. 2. The broom drag had six sets of steel bristles and a single passage resulted in a thorough mixing of the stone and asphalt (left). A single trip of the planer (right), which was of the type formerly employed for leveling up sand and earth roads when mixed-in-place methods were used, eliminated most of the irregularities in the old pavement.

The broom drag followed directly behind the distributor (Fig. 2). This rig was built by the highway department at a cost of $800 and is equipped with six sets of steel bristles. It was pulled by a truck and resulted in a thorough mixing of the stone and asphalt. However, the drag is not too effective in moving stone from the high points to the low places on the road. Therefore, instead of using two passages of the drag, as is sometimes done in North Carolina, the Virginia crew decided to employ one passage of the drag and to follow it with a single passage of a road planer.

The planer (Fig. 2) was originally used for leveling up sand and earth roads when mixed-in-place construction methods were being used. It had been rebuilt by installing the rear dual wheels behind the strike-off blade. This unit was pulled by a smaller tractor and a truck hitched in tandem. Its passage not only assured that the stone would be thoroughly coated with asphalt but eliminated most of the irregularities in the old pavement and resulted in a smooth riding surface.

Final finishing details

Application of 5 lb. per sq. yd. of choke stone distributed with the aggregate spreader preceded compaction of the surfacing, which was by steel-tired tandem-wheel rollers of 5 to 7-ton capacity. Both dolomite and granite material were used as choke stone with their gradation the same as that previously mentioned. Average thickness of the new top was about ½-in.

All the operations described were carried out for a given section of the lane being paved before work was shut down for the day, weather permitting. To use this method of construction a crew of about 15 men on the job were required.

The cost of the work was $2,375 per mile for the full 30-ft. width of roadway.

The work was done by the maintenance forces of the Virginia Department of Highways with J. J. Forrer, state maintenance engineer, H. H. Harris, assistant maintenance engineer, and P. M. Burton, resident engineer at Appomattox in general charge. Sammie Hughes was superintendent on the job. •

Faulted Rock Passed by Grouting On Copenhagen Sewer Tunnel

K. Pilgaard
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***Contents in Brief**—Following an alternate plan suggested by the contractor, a 4-ft. dia. sewer outfall was extended in a tunnel rather than in an underwater trench. However, borings made had failed to show faulted rock that permitted water flows up to 290,000 gph. and penetration of hydrogen sulphide gas. Water flow was overcome by grouting and by bringing tunnel to surface over faulted area while the gas problem was solved by dilution with five times the normal amount of air delivered to the heading.*

UNUSUAL difficulties had to be overcome in constructing a sewer outfall by deep tunneling into the Oresund (Ore Sound) at Copenhagen, Denmark. Unexpected faulted rock on the tunnel line, 90 ft. below sea level, forced extensive grouting and finally required bringing the sewer line to the surface, through additional shafts, to pass a badly broken area.

The work was undertaken to reduce pollution in the harbor and along the beaches as sewage now is merely coarse screened and is discharged only 650 ft. from the shore through outlets built about 1900. Since that time the population of Copenhagen has grown from 450,000 to 950,000. Piers and other works in the harbor also have been extended, interfering with the flow that once was adequate for dilution. By the late 1930's water pollution made the condition of the beaches around Copenhagen intolerable, and methods of alleviating the situation were studied.

The first major step made in clearing up the harbor was to unite the two northern mains, serving a population of 165,000, and to extend the outlet about two miles into the Sound (Fig. 1). A reinforced concrete outfall was to be installed in a trench excavated under water as much as 50 ft. deep.

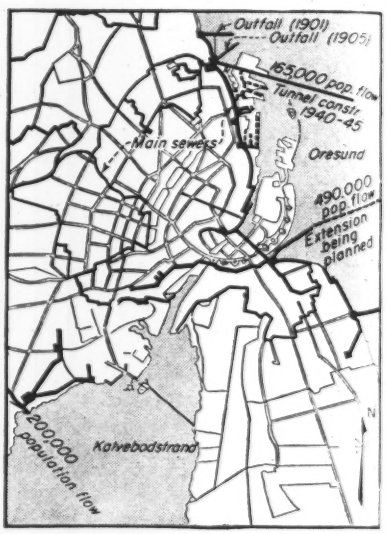

Fig. 1. Copenhagen has alleviated sewage pollution from its northern area by a two-mile outfall extension and contemplates doing the same for the central area.

Contractor proposes tunnel

Proposals on the surface trench construction were asked in 1938. The firm of A. Jespersen & Sons proposed, as an alternate, to place a 48-in. inside diameter precast reinforced concrete pipe in a 12,000 ft. long, 7 ft. high and 8 ft. wide tunnel from 90 to 100 ft. below the surface. The bid was $830,000, which was only a little more than the lowest bid for the trench.

The proposal at the low price was possible because the subsurface material from 30 to 50 ft. in depth and

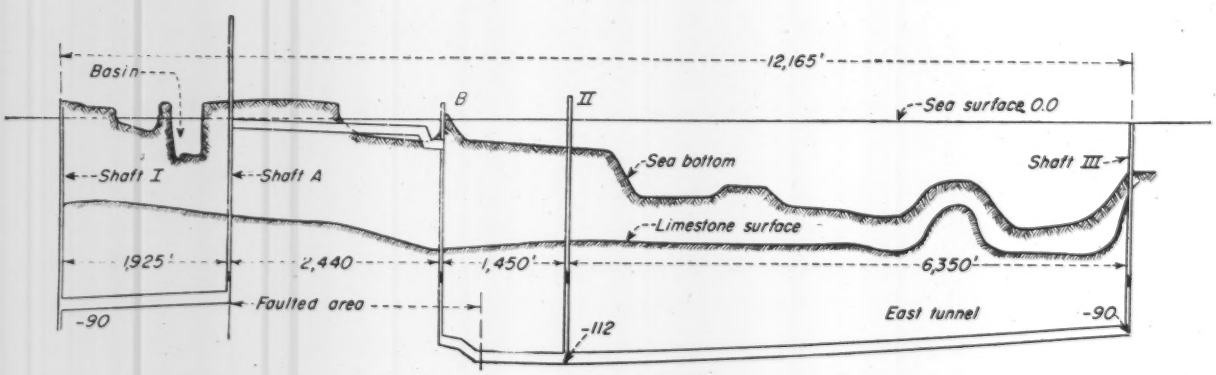

Fig. 2. It was expected that the tunnel would be in solid limestone but a faulted area forced bringing the sewer to the surface across a virtually impassable section. Vertical and horizontal scales on the drawing are in a ratio of 25:1.

several hundred feet down is composed of limestone (Danish: saltholmskalk). It was assumed by the contractor that the tunnel could be driven without lining or any use of roof support.

The advantages of a tunnel were obvious. The concrete pipe could be assembled inside the open tunnel so that the joints could be made absolutely tight. The construction did not interfere at all with the piers or shipping of Copenhagen. Inspection of the pipeline would be possible at any time by pumping the water from the tunnel.

Test borings along the tunnel line —too few, as was discovered later— showed good rock, and the contract was signed in June 1939. The outbreak of the war caused some delay, but construction commenced in 1940.

Tunnel from one shaft

In January, 1941, excavation of the tunnel was started in opposite directions from a 122-ft. deep main shaft (Shaft II, Fig. 2) sunk at about the center of the two-mile length. A 500-kw. power station, six electrically-driven pumps with a capacity of 400,000 gph. at 120 ft. head, compressors with a capacity of 567 cfm., hoists and miscellaneous equipment were installed at this shaft. Excavated limestone was moved in dump cars hauled by an electric locomotive to the shaft and hoisted to the surface for disposal.

The plan was to work in both directions from the shaft until the extreme ends were reached. Then the concrete pipe, in 15 ft. lengths each weighing 5 tons, was to be lowered by derrick and assembled.

Six rounds of drilling, blasting and excavating a day advanced the tunnel some 20 to 35 ft. The story would have been a short one if a large outbreak of water in the west tunnel, outflow of hydrogen sulphide in the east tunnel, a disastrous fire in the main shaft, three hard winters and wartime difficulties had not made construction a long, weary job.

Water flow overcome by grout

Some 1,200 ft. toward shore from the main shaft a sudden inflow of 110,000 gph. of water came into the tunnel. It was found by extensive test borings from the surface that for 750 to 1,000 ft. ahead the otherwise solid rock was broken into blocks with

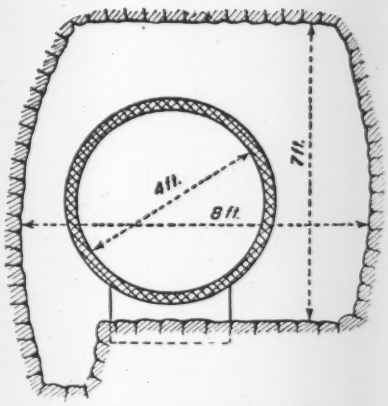

Fig. 3. Precast concrete pipe was used to carry sewage in the tunnel.

water streaming from every crack. There was little alternative to continuing the tunnel through the faulted rock for a distance of 250 ft. more to a point where an auxiliary shaft could be sunk from an existing quay. In this area outflow of water from the rock into the tunnel went up as high as 290,000 gph.

Driving through 250 ft. of faulted rock was exceedingly difficult, but a procedure was finally worked out. First, a 16-in. concrete wall was constructed at the tunnel heading with its ends grooved into the rock sides so that the water was stopped. Then about forty 1½-in. dia. holes 12 ft., 20 ft. and 33 ft. long were extended forward through this wall and into the rock alongside the tunnel line with 40 lb. pneumatic drilling hammers. Finally cement grout was pumped into these holes by pneumatic piston-pumps under pressures up to 200 psi. Thus the tunnel was advanced 25 ft., after which a new wall was constructed and the drilling and grouting repeated.

Almost three tons of very scarce cement were required per foot of advance but the tunnel was made tight.

The sewer line was brought up through auxiliary Shaft B (Fig. 2) at the quay and laid 15 ft. in the ground to pass over some 2,400 ft. of disintegrated limestone until a harbor basin was reached where Shaft A connected the pipe to a 1,925 ft. long tunnel that ended at the shore.

Work under compressed air

Sinking Shaft B in the disintegrated limestone area was accomplished by lowering a reinforced concrete caisson under compressed air that reached pressure up to 50 psi., corresponding to 115 ft. depth. For the first time in Denmark "fast decompression" was used following the method given by N. O. Barrows in his book "Blow All Ballast" (Dodd, Mead & Co., New York 16, N. Y., 1940) concerning the salvage of the U. S. submarine *Squalus*, which had surreptitiously been brought into Denmark during the war. Despite the 50 psi. pressure, the workmen were brought out of pressure in the airlock over the shaft in 5 to 10 min. and then brought under pressure in another larger tank for up to 3

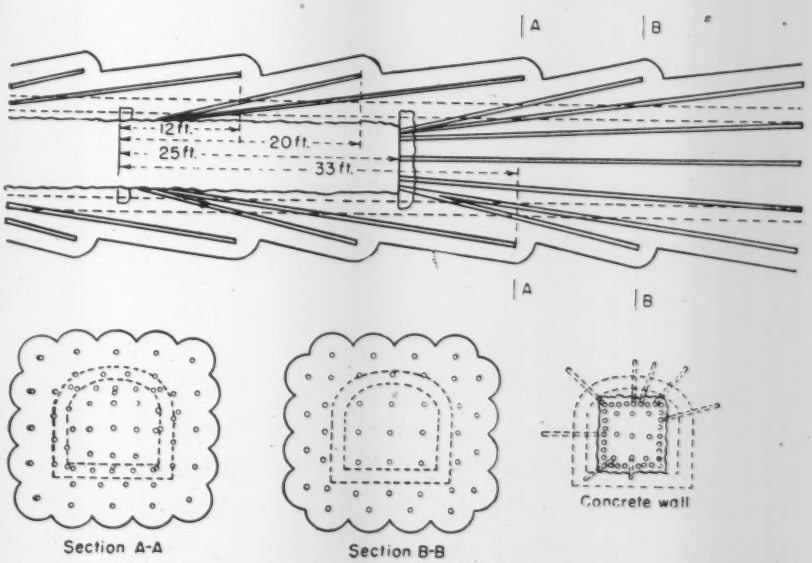

Fig. 4. Holes were drilled forward and grouted to stop flows of water that at one time reached 290,000 gph. through the broken limestone.

hours decompression. Considerable time was saved and the workers had better conditions in the larger and cleaner tank.

Poisonous gases

Hydrogen sulphide gas, which violently and painfully attacks first the eyes and later the mucuous membrane of the respiratory organs was encountered in the excavation. After all conceivable means of combatting the gas and alleviating the condition were tried, the simplest remedy, increase in supply of fresh air, was found to be most effective.

The usual 35 cfs. of air supplied to the heading was increased to 110 and later to 220 cfs., and adequately reduced the discomfort.

The percentage of sulphide gases was checked continuously by titration because a small change in concentration would affect working hours per man considerably. Stoppage of air flow caused a deadly concentration in half an hour. It was found that a portion of 1:6,000 would restrict a man's working capacity to two hours, while 1:10,000 would permit six hours a day, and 1:30,000 would be completely harmless.

Tunneling difficulties delayed the job so that the sewer conduit was not put into operation until October 1945, and the originally estimated cost of $830,000 grew to $1,130,000. However, functioning of the conduit has been most satisfactory. Without pumping, and merely under a hydrostatic pressure of 18 in., discharge of sewage is 11 mgd. Pumping can increase the discharge to about 52 mgd. Current at the location of the discharge is such that the problem of water pollution has disappeared completely from the northern main of the sewer system of Copenhagen.

Despite the difficulties encountered during construction of this tunnel, the city of Copenhagen and the contractor are planning a tunnel for extension of the southern main serving a population of about half a million. Extensive test borings are being made now to determine the best location for the tunnel.

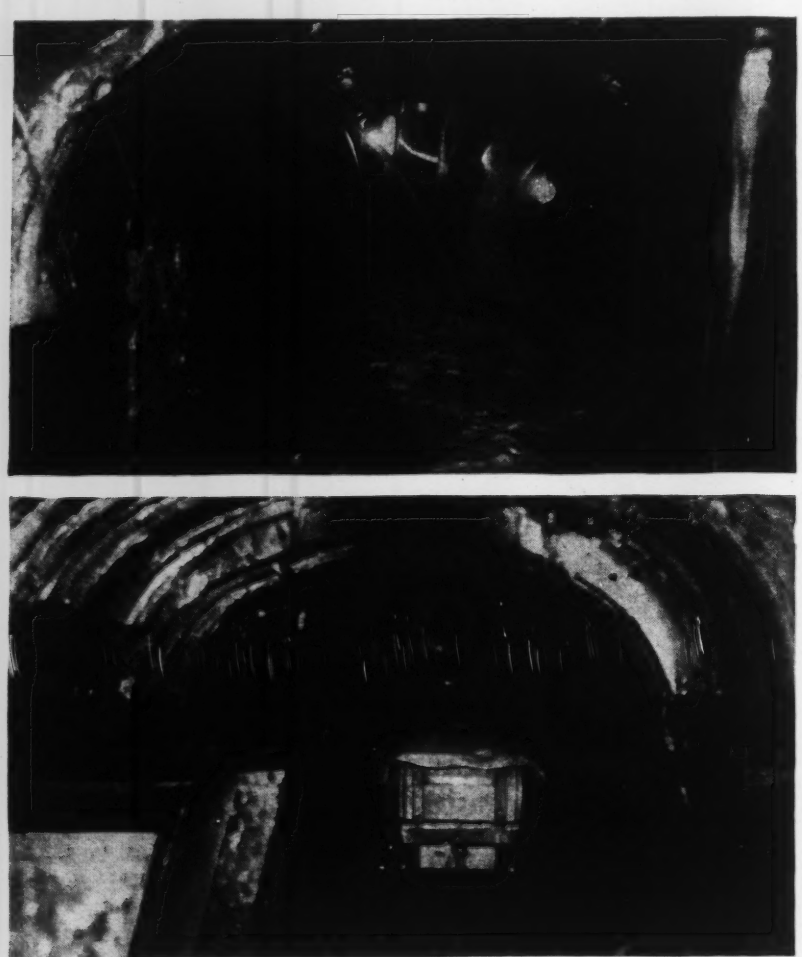

Fig. 5. Before and after grouting in one section of the Copenhagen tunnel.

Alkali Reaction in Concrete Investigated

The possibility of reaction between alkali set free in the hydration of cement and certain minerals occurring in concrete aggregate has been suggested as being responsible for many cases of concrete deterioration through expansion and "map cracking" of the surface. To investigate this question, Committee C-1 on Cement of the American Society for Testing Materials appointed a subcommittee in 1941, which submitted a report and bibliography in 1943 (*Proceedings* ASTM, vol. 43, p. 195).

In 1944 the committee, in conjunction with the Portland Cement Association, the National Bureau of Standards and the New Jersey State Highway Department, undertook an investigation of the method commonly employed in laboratories for studying the reaction between aggregate and cement. Consisting of testing combinations of the active aggregate with cements of various alkali contents, this method, known as the mortar-bar expansion test, has sometimes yielded conflicting results.

The committee reports (*Bulletin* ASTM, Oct., 1946, p. 28) that, with cements containing 0.58 percent soda equivalent or more, a general trend toward greater expansions with increased alkali content was evident. The amount of expansion from a single test was found not to be entirely reliable and it was believed that the great variations in results were inherent in the test. However, a single test can be relied upon to determine whether or not an aggregate is highly reactive. In the case of slowly reactive aggregates, the activity cannot reliably be obtained from a single test, but if sufficient specimens containing cement in excess of one percent of alkalies (soda equivalent) are made from different batches of mortar and are observed for an adequate period of time, the test can be relied upon to reveal their activity.

Beam Deflections Under Combined Loads

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***Contents in Brief**—For combined axial and transverse loads, the maximum deflection of a simply-supported or restrained beam may be closely approximated by a simple formula derived from the differential equation for this loading condition. The formula is based on a relationship between the radius of curvature of the bent beam and the deflection.*

STRESSES IN BEAMS subjected to axial and transverse loads depend on the deflections of the beams as well as on the loads. An exact analysis involves differential equations, the solutions of which generally result in expressions that require the use either of trignometric functions or of tables of equation constants. However, by an approximate formula developed in the following, maximum deflections may be computed that, within the limits of general design practice, agree favorably with more rigorous solutions.

The general differential equation for the elastic curve of a beam subjected to the conditions of loading shown in Fig. 1 is:

$$Hy + M'' + M = EIy'' \qquad (1)$$

where M is the moment produced by the vertical loads at any point at distance x from the origin, M'' the moment at this point due to the restraining moment M', y the deflection, H the axial load, E the modulus of elasticity, I the moment of inertia and y'' the second derivative of y with respect to x.

Divide both sides of Eq. 1 by the expression $(1 + y'^2)^{3/2}$, where y' is the first derivative of y with respect to x and note that $y''/(1 + y'^2)^{3/2} = 1/R$, the curvature, or reciprocal of the radius of curvature, at the point (x,y). Thus,

$$\frac{Hy + M'' + M}{(1 + y'^2)^{3/2}} = \frac{EI}{R} \qquad (2)$$

At the point of maximum deflection, $y' = 0$ and the denominator of the left hand side of Eq. 2 becomes unity. Hence, with the variables at the point of maximum deflection denoted by the subscript c, Eq. 2 becomes

$$Hy_c + M''_c + M_c = \frac{EI}{R_c} \qquad (3)$$

For commonly used sizes and spans of beams, R_c is very large relative to y_c. Without any significant error, therefore, R_c in terms of y_c may be expressed as

$$y_c = \frac{(kL)^2}{8R_c} = K^2\frac{L^2}{R_c} \qquad (4)$$

where k is a constant depending upon the elastic properties of the beam and the loading (Fig. 1) and $K^2 = k^2/8$. Substituting R_c from Eq. 4 in Eq. 3 and solving for y_c gives an equation for the maximum deflection produced by all the loadings.

$$y_c = \frac{M''_c + M_c}{\dfrac{EI}{K^2L^2} - H} \qquad (5)$$

By rearranging terms, Eq. 5 may be expressed as follows:

$$y_c = \frac{1}{\dfrac{1}{\dfrac{K^2L^2M''_c}{EI} + \dfrac{K^2L^2M_c}{EI}} - \dfrac{H}{M''_c + M_c}} \qquad (6)$$

With $H = 0$, Eq. 6 determines the deflection Y_c due to the transverse and end-moment loadings acting independently; i.e.,

$$Y_c = \frac{M''_cK^2L^2}{EI} + \frac{M_cK^2L^2}{EI} \qquad (7)$$

The indeterminacy of K in Eq. 6, since this constant is a function of the combined effect of all loadings, does not permit a direct evaluation of the resultant deflection, y_c. For example, considering the deflection with the horizontal load not acting, as expressed by Eq. 7, K^2 for a uniform load would be 5/48 or 0.1042 and for a centrally-applied concentrated load, 1/12 or 0.0833, and would be neither of these values for a combined uniform and concentrated load.

Application of the principle of superposition to Eq. 5, however, does make possible a determination of the resultant deflection, which, although approximate, yields results that are within the allowable error of usual engineering practices. Expansion of Eq. 5 indicates that the total deflection may be expressed as the sum of deflections caused by the separate loadings acting with the horizontal load; i.e.,

$$y_c = \sum \frac{1}{\dfrac{1}{Y_c} - \dfrac{H}{M_c}} \qquad (8)$$

where Y_c is the simple beam deflec-

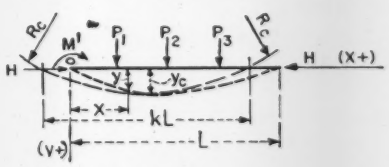


Fig. 1. The maximum deflection of a beam subjected to transverse and axial loads may be obtained with good accuracy by using an approximate value of the radius of curvature.

DEFLECTIONS OF BEAM UNDER COMBINED LOADS

Loading	Midspan Moment (ft.-lb.)	Midspan Deflection (H = 0)	Midspan Deflection, including H = 3,000 lb.	
			Eq. 8	Timoshenko
U.L. 50 lb. per ft.	2,500	0.083	0.093	0.084
C.L. 1,000 lb.	5,000	0.133	0.145	0.150
End-Mom. 2,000 ft.-lb.	1,000	0.040	0.046	0.045
Total	.....	0.256 ft. (3.07 in.)	0.284 ft. (3.41 in.)	0.279 ft. (3.35 in.)

tion corresponding to the loads producing the moment M_c.

In general design practice, especially in the case of building frames and similarly loaded structures, the use of Eq. 8 is very convenient. Critical values of the bending moments under the usual building loads occur at the ends and midpoints of the spans. After the moments for the individual loadings have been obtained, the respective deflections may be calculated by the direct application of the simple-beam formulas in the case of transverse loads and in the case of end-moment loadings, by the conjugate-beam theory or numerical methods ("Numerical Procedure for Computing Deflections, Moments and Buckling Loads", by N. M. Newmark, *Transactions*, Am. Society of Civil Engineers, Vol. 108, 1943, p. 1, 161).

In the following example (Fig. 2), the method of using Eq. 8 is demonstrated and comparison made with values obtained by the more rigorous analysis of S. Timoshenko ("Theory of Elastic Stability", Engineering Societies Monograph, New York, 1936, p. 1 to 15). The relatively small depth of beam, which is 1/60 of the span, was chosen in order to demonstrate the insignificant difference between the deflections determined by

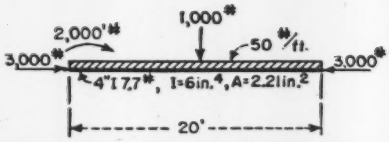


Fig. 2. Combined loading on beam with depth to span ratio of 1:60.

the approximate and the more strict methods of analysis.

The deflections at midspan computed by means of Eq. 8 and the formulas of Prof. Timoshenko are given in the accompanying table. The midspan deflections with $H = 0$ were obtained in the case of the uniform and the concentrated transverse loads directly from equations $5M_cL^2/48EI$ and $M_cL^2/12EI$, respectively, whereas the deflection that is produced by the 2,000 ft.-lb. end-moment was determined from a consideration of the conjugate, or M/EI, beam loading. These values were then substituted in Eq. 8 and the total mid-span deflection, including the effect of the axial load of 3,000 lb., calculated. Upon comparison, it is seen that the results obtained by the approximate and more exact methods are in agreement.

The total moment at midspan, including the effect of the axial force, is: 2,500 + 1,000 + (3,000 × 0.0455) + 5,000 = 8,637 ft.-lb. It is evident that a negative end moment would cause a corresponding upward or negative deflection. Moreover, Eq. 8 was derived considering the axial force H as positive; a tensile axial force, therefore, would be negative, in which case the two expressions in the denominator of Eq. 8 would be additive and the resultant total deflection a lesser value.

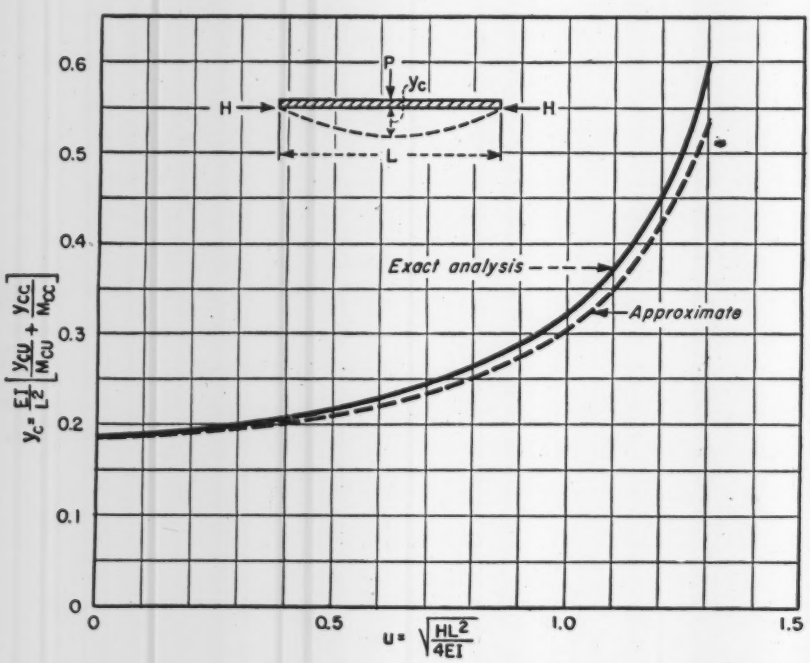


Fig. 3. Deflection curves compared for exact and approximate methods for the case of an axially loaded beam with a transverse uniform load and a concentrated load at midspan.

Limitations of the formula

Comparisons of the expressions for the elastic curve as defined by Eq. 8 and the more rigorous treatment indicate that maximum divergence in results will occur in the case of a concentrated load applied at midspan. Under this condition of loading, the value of H that will produce buckling when the beam is subjected to a transverse load of infinitesimally small magnitude is equal to π^2EI/L^2, according to the exact analysis. However, if the denominator of Eq. 8 is equated to zero, the corresponding critical load as determined by the approximate analysis is M_c/Y_c. In the case of a beam, the transverse load is produced by its own weight, so that the critical load is $48\ EI/5L^2$, different from the exact analysis by only 2.6 percent.

This error, however, is not constant throughout the intermediate range of deflections, and the case of an axially loaded beam subjected to a combined uniform load and centrally applied concentrated load would be a more logical basis for comparison. For this condition of loading, Eq. 8 may be expressed in the following form:

$$y_c = y_{cu} + y_{cc}$$

where y_{cu} is the deflection for the uniform load and axial load combined and y_{cc} for the concentrated load and axial load combined.

In Fig. 3 is indicated the effect of variations in H on deflections, as computed by the exact and approximate methods. For the critical value of H, the plotted curves are asymptotic and the deflection equal to infinity. At 50 percent of the critical axial load, the discrepancy between the two curves is 4.7 percent; at 40.3 percent of the critical axial load the discrepancy is 3.7 percent.

The writer wishes to acknowledge the help of F. T. Mavis, head of the Department of Civil Engineering, Carnegie Institute of Technology.

Fig. 1. Custom-made garbage trucks in Dallas have large loading hatches for bulky material.

Dallas Builds Own Garbage Trucks

***Contents in Brief**—Garbage and refuse collection trucks designed to meet specific needs of Dallas are fabricated in the city's own maintenance garage. Of all welded, steel construction, the garbage trucks are fully enclosed, with a traveling tailgate operating as a power packer. Refuse trucks are open-top, mounted on 1½-ton truck chassis.*

ALL-WELDED, fully-enclosed garbage collection trucks designed for easy loading and mechanical ejection of the compressed refuse, and fabricated in the Dallas, Texas, municipal garage, are reported to be turning in a very satisfactory performance in the collection of that city's garbage, which averages about 12,000 tons per month. One of the chief features of the truck includes unusually large openings on each side, in front, that will accommodate cardboard cartons and other bulky material which often prove to be too large for the smaller openings sometimes provided.

A traveling tailgate shaped to fit the interior of the body, and operating on an endless chain not only compacts the refuse during loading, but also insures quick and positive ejection at the sanitary fill. Each truck holds about 15 cu. yd. of garbage.

The city owns and operates five of these garbage collectors, the first of which was built about five years ago at a total cost of $900. They are used principally in the downtown business district of the city. Loading height of truck is 5 ft. above the ground.

In structural make-up, the truck body consists of a flat-bed frame 15 ft. long by 8 ft. wide made of 4-in. transverse channels resting directly on two longitudinal channels spaced to match the frame of a conventional truck chassis. The 6-ft. central width of transverse channels is covered with a $\frac{3}{16}$-in. smooth black iron plate, notched 1 in. on the centerline to accommodate the endless chain that operates the traveling tailgate.

The outer 12 in. of the transverse channels are covered with a $\frac{3}{16}$-in. thick raised-ribbed plate to form a 12-in. shelf along each side of the truck body. This same material is used as facing along the ends of the transverse channels, and across the two end channels.

Welded to the flat-bed frame is the enclosed truck body, 6 ft. wide by 15 ft. long. It has an over-all height of 5½ ft. above the bed, with sides 4 ft. high and a roof curved to a 45-in. radius.

The framework of the truck body includes $1\frac{1}{4}x_{16}^{3}x1\frac{1}{4}$ structural tees faced on the inside with 10-gage sheet iron for the sides and 12-gage over the curved roof.

Wide loading hatches

A pair of light channels extending along the sides of the truck 2 ft. above the bed stiffen the ribbed framework and serve as runners for sliding doors covering the 36-in. wide loading hatches. Light angles welded at the apex of the roof form the top track for the hatch covers.

Two 4-in. channels extending along the centerline of the truck bed, set face to face with a 1-in. clearance between toe of flanges, form a working slot for the endless chain operating the traveling tailgate.

The tailgate is made of 10-gage black iron, stiffened with light angles and fabricated to fit the inside of the truck body with about 1 in. clearance at the top and on the sides. It is sup-

ported on three light roller assemblies; one on each side that rolls on the truck bed and one in the center that operates on the bottom flanges of the two longitudinal channels forming the slot for the endless chain.

Power for propelling the traveling tailgate while it is operating as a packer, or when ejecting the refuse and garbage at the sanitary fill is provided by a standard power take-off from the truck motor. Using what material was at hand, the garage mechanics removed the drum from a standard winch and mounted a sprocket wheel on it. This sprocket-winch was mounted on the truck chassis between the cab and the truck body and geared to the power take-off.

An endless chain engaging the sprocket wheel on the winch and bolted to the center roller assembly of the tailgate completed the mechanical arrangement for propelling the tailgate back and forth inside the truck.

Fig. 2. Traveling tailgate propelled by an endless chain, sprocket-mounted winch and power take-off from the truck motor packs the garbage while loading and ejects it at the sanitary fill.

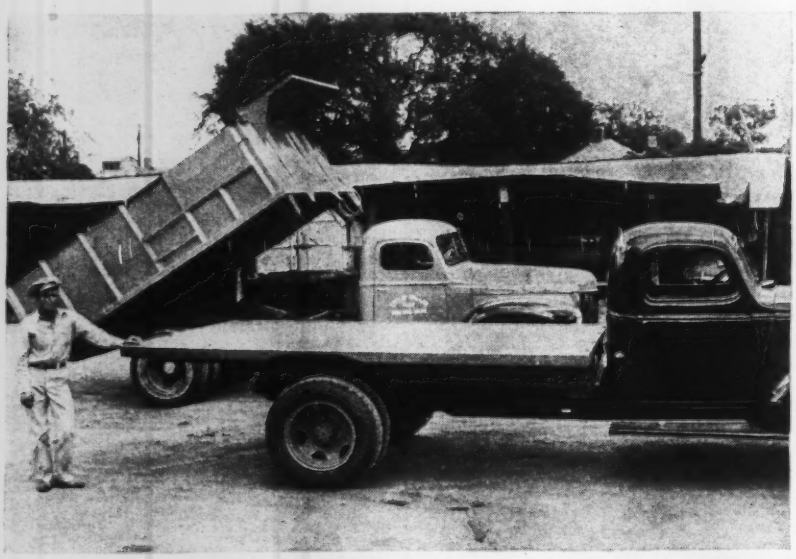


Fig. 3. All-welded, open-top steel truck bodies welded to a truck-mounted, flat bed serve the residential area.

As a rule, all garbage is collected at the alley entrances to residences but refuse such as brush, grass, leaves and shrub trimmings are collected from the street chiefly because of the obstructions to high loads from overhanging branches of trees lining the alleys.

Continuing its policy of designing refuse collection equipment to suit its needs, the city is building twelve 10-cu.yd. open-top refuse and garbage collection trucks for use in the residential areas. Like the enclosed trucks, they are welded throughout, and made of 12-gage sheet iron on structural framing. They are mounted on a standard 1½-ton truck chassis and operate as end-dump trucks.

The body of these open trucks measures 7 ft. wide, 12 ft. long and 36 in. high. Two 36-in. loading openings, with removable side boards, are provided at the front end of the body. Loading height is 5 ft. above the ground.

Collection schedules

In general, garbage is collected twice a week and other refuse once a week in the residential areas of Dallas. In the downtown district these collections are made on a basis of three or six times a week, depending on the location and amount of garbage involved.

Garbage and refuse collection charges, which became effective last Oct. 1 are expected to produce a revenue to the city of $1,400,000 annually. Monthly collection rates in the business sections include $1.00 per garbage can for three pick-ups per week and $2.00 per can where the garbage is collected six times a week. In the residential sections a flat rate of $0.90 per month is charged to each residence, including each family in apartment buildings.

Development and fabrication of the all-steel, welded garbage and refuse collection trucks owned and operated by Dallas was under the direct supervision of W. L. Fisher, superintendent of the municipal garage. Granville Brinkley is superintendent of the city's Division of Sanitation, J. C. Bisset is director of public works and V. R. Smitham is city manager.

California's Highway Needs Examined in Relation to Funds

Special attention is now being focused on analysis of California's state highways because the state legislature has been called by Governor Warren to a special session to be devoted to the sole purpose of considering highway legislation. Highways, according to the Governor, are California's No. 1 problem.

Special committees of the state legislature for some time have been studying an increased highway construction program together with means for the necessary financing. Senator Randolph Collier, who heads a joint legislative fact-finding committee on highways, has indicated that his committee will ask for legislation of the type recommended in a report on "engineering facts" recently considered by his committee (*ENR* Nov. 7, 1946, vol. p. 609).

Another report entitled "Analysis of Taxation for Highway Purposes", while not making any recommendations, indicated that the tax revenue in California available for highway purposes is lower, per car, than in any other state. This suggests the possibility of increasing the present 3-cent gasoline tax to get more money from that source.

A third report submitted to the legislative fact-finding committee is entitled "A Proposed System of Highway Financing for the State of California." It contains specific recommendations on a new highway user tax plan for California which are as follows: (1) Continue the $3 registration fee on all vehicles; (2) a gasoline tax of either 4 or 4½ cents per gallon compared with the present 3-cent tax; (3) diesel fuel taxes 50 percent greater than the gasoline tax; and (4) increased taxes on trucks, trailers, and buses.

A very comprehensive summary of California's state highway situation was made by C. H. Purcell, director of public works, in a paper read before the California State Chamber of Commerce in San Francisco Dec. 4, 1946. The following is briefed from Mr. Purcell's paper.

At the end of the war there was a sizeable program of projects planned and ready for contract including the most necessary work on the California highway system. This program has since been enlarged by additions, such as plans for the replacement of bridges that have become dangerous by reason of structural failure, etc. In the year ended June 30, 1946, the California Highway Commission approved for construction proposed work amounting to some $160 million. From this approved list a portion amounting to $44.5 million was put under way during that year.

Not enough money for construction

In the second postwar year (ending June 30, 1947) the construction program has been allotted another portion of work from the approved list totaling $52,500,000. Of this sum, at the end of the first quarter of the fiscal year, $4,500,000 had been put under way. By June 30, 1947, the end of the current fiscal year, construction projects amounting in dollar volume to all the funds available for construction purposes will have been put under way and there will be left, yet to be financed, more than $60 million of critical projects approved for construction and for which no financial program has been worked out. In other words, so far as concerns new construction for the remainder of this fiscal year, "the state is already broke."

This is not a new situation in California. For years there has been a tendency to run behind. Early in 1943 the Division of Highways tabulated what were called "accumulated critical deficiencies." This list, covering roads of inadequate capacity, structurally weak bridges, obstructions to traffic, etc., was estimated to amount, at that time, to $700 million. In other words, at the beginning of the war so far as an adequate system was concerned, the state was already $700 million in the red.

This is serious because "the present general welfare of California, and to a major extent its future expansion, is to a very great degree dependent on motor transport. Commercial trucks regulated as common carriers operating on California's highways receive two-thirds of the freight dollar. California moves on rubber, and there is every reason to believe that it will continue to use rubber-borne transport as the principal means of transportation."

While it is true that there has been an ever-increasing over-all return from highway user funds, at the same time there has been a more rapidly increasing cost of traffic service per vehicle unit. The wider traffic lanes, multiple lane highways, flatter curves, lesser grades, channelization schemes, etc., have increased the cost of providing better and safer service. While motor fuel taxes have produced increased income (25 percent since the war), highway construction costs have increased much more (some 60 percent) as compared with prewar costs. In other words, while $1.25 is available now where only $1 was collected before the war, the amount of road that could be bought with $1 before the war now costs $1.60.

All this comes down to the simple essential that the average motor vehicle has not paid enough money for highway purposes to provide an adequate and proper facility upon which to operate.

"The outstanding and most critical deficiency on the entire 14,000 miles of the state highway system today is inadequate lane capacity. There are over 2,000 miles of state highways today that should be expanded to provide additional lanes for moving traffic. On these congested roads—both outside cities and, more particularly, within cities and metropolitan areas—occur the majority of traffic accidents; and here also are developed the big losses in time and operating costs. * * * In other words, it is actually costing the motor vehicle owners of California more money to own and operate the present unsatisfactory system than it would cost to construct and operate facilities that would provide safe and efficient traffic service."

Traffic congestion and resultant traffic accidents cannot be reduced permanently by any method other than the application of engineering science to the construction of the highway itself, Mr. Purcell said. Panaceas and palliatives looking toward traffic accident prevention do not suffice and the important need in order to relieve the traffic accident situation is to provide more room for the operation of motor transport.

Difficult Barge-Holding Problem in Blasting a Submerged Rock

PROBLEMS for which little precedent was found have beset, from the very outset, the endeavor to blast away Ripple Rock, long a menace to navigation in extremely dangerous tidal currents that surge through Seymour Narrows. This half-mile width of turbulent water, the narrowest point in the long inside passage between Vancouver Island and the mainland of British Columbia, is a veritable graveyard for ships because wide tidal fluctuations cause currents to race through the narrows at such speed that only fast steamers dare to defy them.

Ripple Rock, near midpoint in the 2,600-ft. strait, occupies an area of 175x250 ft. and at low tide is only 10 to 14 ft. under the surface. This channel obstruction, combined with tidal velocities ranging up to 14 knots, causes almost unbelievably rough water with boils, whirlpools and overfalls. In this maelstrom it is so difficult to avoid the rock that many vessels have crashed upon it and sunk, including two U. S. warships, the Saranac and the Waschusett, and the Dominion hydrographic steamer William J. Stewart. The latter, which was at the time engaged in surveying the rock, took with it to the bottom a half million dollars' worth of scientific instruments.

Although it is reported that early attempts to remove Ripple Rock date back into the previous century, nothing effective was then accomplished. Much later, a large contracting firm is said to have attempted to moor over the rock a barge of the conventional scow-type 90 ft. long and 30 ft. wide. After mooring, as the tide increased in velocity, the barge started swaying from side to side until it finally nosed under and capsized. Thus, nothing had been done toward improving the Seymour Narrows channel up to the time that the importance of wartime shipments to Alaska focused attention on the inside passage. Then a project for removal of the rock was undertaken, and carried out in part, as a wartime measure.

This work got under way in 1943 using methods decided upon after tests were made on a hydraulic model of the channel built in the laboratory at the University of Washington. This model, on a scale of 20 ft. to the inch, was made to encompass the entire Seymour Narrows channel and particularly the peculiar shape of the rock itself in which the navigation menace is a pinnacle rising some 600 ft. from the remainder of the base.

Turbulence around the pinnacle was believed to be increased by cross currents that come in through a nearby strait between Quadre and Maude islands. It appeared desirable to close off this strait by constructing a low dam and this was done as a preliminary to the main undertaking. First work on the rock itself in the recent project was done with a specially constructed drill barge of novel design described in detail in *Engineering News-Record* July 1, 1943, vol. p. 27.

Mooring lines shake apart

Upon completion of this barge and before it was sent to the job, the interested underwriters required that some tests of its stability be made—stories about the dangerous waters over Ripple Rock had not been without their effect. In compliance with the underwriters' recommendations, the barge was taken out into the Gulf of Georgia behind a powerful tug with one end of the towline attached to a hydraulic gage.

The barge was towed at various speeds and angles. These tests, it was reported, showed that the barge had ample stability at angles as much as 45 deg. from the course of the towing vessel and that the strain required to hold the barge head on to a 12-knot current was about 22,000 lb., or, at an angle of 45 deg. almost broadside, about 34,000 lb. After these tests the barge was approved and was towed to Ripple Rock.

In position for starting to drill, the barge was held in place by transverse as well as fore-and-aft anchor lines, some of which went to 250-ton concrete blocks that had been dropped overboard from barges at appropriate locations. Later this plan of anchoring had to be abandoned because of excessive vibration set up in the transverse anchor lines by the swift currents. The fore-and-aft lines (up- and downstream) were relatively free from damaging effect but those transverse to the current were in such continuous and violent vibration that the cables soon broke.

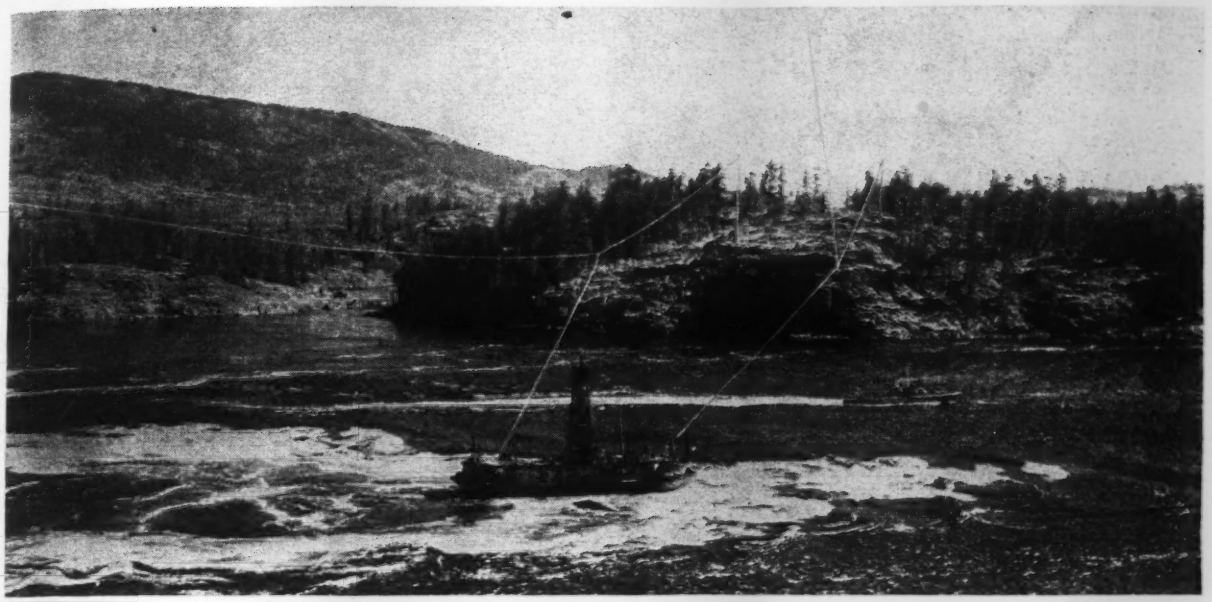
Before the original anchorage system, including transverse anchor lines, was abandoned, determined effort was made to increase resistance of these lines to the destructive effect of vibration. But even 2⅛-in. cables literally smoked from internal friction during those tide stages that produced maximum vibration. None of the attempts to stop the vibration on these submerged cables were of any avail.

Overhead cables successful

The use of overhead cables that would make it possible to keep the transverse anchor lines entirely out of the water was then decided upon. The actual 2,600-ft. width of the channel is less than the span length required in transverse cables because in order to leave the channel unobstructed, it was necessary to use a high elevation that could be obtained only with supports on the hill well back from the water's edge.

For this purpose a pair of spars was erected on each side of the strait about 300 ft. apart and 100 to 150 ft. high. The two cables strung between these pairs of spars had a 3,600-ft. span and were 1¾-in. diameter. They were taken across the strait on 30 floats, each consisting of two 50-gal. oil drums. The narrows had to be closed to navigation for several hours during this operation in which a cable-laying barge and five tugs moved the cables into position.

In order to minimize the time during which the channel would be closed to navigation, the concrete anchorages behind the spars were first installed and both ends of each cable were placed over the ironwood saddles on top of the spars and led thence to the anchors. On the Vancouver Island side, the end of the cable was attached to the anchorage, was led over the spar and thence to a reel mounted on a barge. The reel was some 11 ft. long, had a 6-ft. barrel and rims high enough to



Drill barge on Ripple Rock had up-and-downstream cables to 250-ton concrete anchors in deep water; transverse anchor lines, kept entirely above water to escape destructive vibration, lead to aerial cables that were strung entirely across the 2,600-ft. channel. Work has been left uncompleted due to lack of funds.

accommodate some 3,000 ft. of the 1¾-in. cable.

When the time for closing the channel arrived this barge was towed across the narrows as the cable was paid out. When the barge reached the opposite shore the end of the cable was attached to the end of a 600-ft. length of cable that had been led over the spar from the opposite anchorage. The outer end of the 600-ft. length was carried through an open socket on the end of the 3,000-ft. length. Later the slack was taken up and the proper tension put in the line by tackle installed at one of the anchorages.

With cable spans across the strait it was possible to put quarter lines to the overhead cables, thus keeping them entirely out of water. The fore-and-aft cables to the heavy anchors or to suitable points ashore did not give serious vibration trouble. With this system of anchorage the barge was satisfactorily held "quite steady and stable enough for drilling" at tidal stages suitable for drilling.

This demonstration of success in overcoming the terrific vibration in transverse lines is considered to be the most important development in the entire undertaking. It proved that the plan was workable even though the project was not carried to completion at this time.

The drill tower, as described in the previous article, was mounted on one side of the barge and was fitted on skids with free movement fore and aft. Two drills were set up on this tower about 6 ft. apart. In early stages of the work attempts were made to use the two drills simultaneously but without much success. The successful drilling progress was made with a single drill.

Major work remains

Drilling operations were carried on in the latter part of the work much more successfully than previously and about 5,600 sq. ft. of the top of the rock is reported to have been blasted out to a depth of 6 ft. To complete the drilling job as a whole will require a total of 1,000 and 1,500 holes put down to depths ranging up to 25 ft. In work being done when the project stopped, these holes were made 6½ in. in diameter and were loaded with about 3 lb. of explosive per foot of hole. The objective in this arrangement was to remove the top of the rock to a level such that the water depth will be at least 35 ft. over the rock at low tide.

The drilling had to be done without the aid of inspection by divers as the water is too rough to permit of diving. Drills were attached to a spud hung in the drill tower over the edge of the barge and could be operated only during the period of relatively slack water. The feasible operating range was usually up to an ebb tide of 6 knots or a flood tide of 8 knots.

Wide variations were found in the quality of the rock drilled. It varied from a hard greenstone to what is known locally as graywacke. Progress with the drills ranged from 45 min. to 7 hr. for the 5-ft. depth which was ordinarily attempted at one drill setting. The greatest depth drilled at any one setting was 16 ft. which was accomplished in about 5 hours.

Based on experience up to the time the work was shut down, it was believed that feasibility of carrying on the work with the equipment used had been demonstrated. However, slight improvements in the rig were suggested as follows: Stiffen the upper works on the barge, increase the spread between overhead cables and provide more power in the mooring winches.

Removal of the top of the rock was done under an arrangement between the Dominion government and the British Columbia Bridge & Dredging Co., Ltd. The work was discontinued and equipment was removed when appropriations were exhausted and there appeared to be no immediate prospect for more funds.

Machine Grouts Joints in Trunk Sewer

C. S. Seabrook
Sewer Engineer, Department of Public Works
Tacoma, Wash.

Contents in Brief—When Tacoma planned to build, below ground-water level, a 54-in. trunk sewer from which the discharge will always have to be pumped, tight joints to prevent infiltration were vital. The desired tightness was obtained with a newly-developed machine which uses an air jet to pack the joints quickly and tightly with grout.

STRONG EMPHASIS on the need for watertight joints in a new trunk sewer at Tacoma, Wash., resulted in trying out the plan of filling them with grout "shot" in under pneumatic pressure by a newly-developed grout-placing machine. Not only has this method succeeded remarkably well but also the human equation in the old hand-packing method is largely eliminated in that all parts of the circumference are packed firmly in place with equal thoroughness and form a perfect bond with the material of the concrete pipe itself.

The project is known as Unit No. 1 of the south Tacoma trunk sewer, authorized under a $3,000,000 bond election in 1944. When completed the trunk will be an 8-mile length of reinforced concrete pipe varying in diameter from 24 to 54 in., serving a large portion of the southerly half of Tacoma.

Two outstanding features of the project posed a particularly aggravating problem in design. First was the fact that the entire sewer would lie from 5 to 10 ft. below the water table and, second, that the entire discharge from the sewer would have to be pumped.

These features made it mandatory that the line be constructed in such a way as to practically eliminate infiltration. Otherwise, the city would be endlessly wasting money in pumping ground water. Even more important, by monopolizing the capacity of the line, to the exclusion of the sewage for which it was designed, infiltrating ground waters could very seriously impair the usefulness of the whole trunk.

Fig. 1. Under air pressure a stream of grout is working upward on one side of a joint in a 54-in. pipe. Note appearance of portion of previously completed joint in right foreground.

Joint types compared

Because the joints in this line would be so important, careful attention was given to a comparison of various types of joint construction. Conventional mortar joints can be made theoretically watertight but so rarely are they found to be so in fact that they were discarded. Asphaltic joints of any type are considered to be satisfactory under ideal conditions but as such conditions were not expected on this job that type was likewise rejected.

By a process of elimination the conclusion was reached that for this job the type of joint wanted was one in which cement grout is forced into place by a method similar to guniting. In the investigation, two difficulties were recognized that would be encountered with a standard gunite machine; the nozzle is too large and too high a pressure is required. However, the solution of these problems was anticipated despite the fact that this method had never been used previously for sewer joints, and, consequently the decision was made to specify "gunite joints" for this job.

At about the time this decision was reached it was discovered that at one time Ben Mason, materials engineer for Seattle, and William McNamara, sewer maintenance enginer in that city, had explored this same idea about pipe jointing with air applied mortar and had gone so far as to make a few sample joints in the laboratory. The process had never been used on any jobs, but the laboratory joint was so perfect that the writer was more thoroughly convinced than ever that this was the

answer to the Tacoma problem. Specifications were prepared accordingly, calling for joints made with a gunite machine or equal and including an alternate bid on conventional mortar joints merely as a factor of safety.

The contract was awarded on the basis of the air-applied mortar joints for about $370,000 which was $12,000 higher than the price on mortar joints. This additional cost may seem high at first glance but considering that it was a new venture, 3 percent of the cost was not considered too high for insuring first-class joints.

New joint machine invented

At this point fortune smiled again. Almost simultaneously with the awarding of the contract, Ben Nickolson, Seattle, announced completion of a newly-invented machine particularly designed for the jointing of sewer pipe by the method required in the specifications. There are three principal differences between the Nickolson grouting machine and the ordinary gunite machine. In the Nickolson machine the nozzle is $\frac{3}{8}$ in. in diameter, it operates on only 35-lb. pressure and the mixing of the dry sand and cement in the machine is accomplished by means of air jets. This feature is the basis of his application for a patent.

The machine was tried out in the yard on several joints and then was operated several days on the job. In these tests, the performance was so completely satisfactory that it was at once approved for the project as a whole. Since then it has been used in making all joints on the Tacoma job.

The machine is comparatively small. It has a capacity of $3\frac{1}{2}$ cu. ft., is mounted on rubber-tired wheels and is wheeled along a wooden plankway constructed above the top of the pipe. The compressor is on the bank. Sand and cement are lowered from the bank in buckets along a wooden trough. Dry sand and cement are screened into the machine, thoroughly mixed with air jets and delivered to the nozzle dry, at which point the water is introduced. Valves at the machine control the mixing and cement-sand delivery; valves at the nozzle control the water.

A notable feature of the machine is an arrangement whereby a water jet alone (without the sand-cement mixture) can be delivered from the nozzle by merely pressing a spring valve. Thus, in joining two sections of pipe the first step is the thorough washing of the joint with the water jet. This is done by beginning at the top and working down. Next, beginning at the bottom, the grout is "shot" into the joint, working up on each side of the pipe to the top.

Fig. 2. Grouting machine (foreground) and air compressor (background) are here working in the trench over the pipe. Vapor from jet appears in left center.

Joints of high quality

The material in place is ordinarily too hard and too well compacted to be dented with one's finger immediately after the joint is completed. For the 36-in. pipe of the bell-and-spigot type used, which has an unusually large bell, about 1 cu. ft. of material is required to make each joint. Even in a trench filled with cribbing and falsework, with limited space and under bad water conditions, each joint requires only 5 to 8 min. to complete. No visible quantity of splatter or waste material is apparent around the trench. No hand finishing of the joints is attempted as a hand-troweled finish is not considered to be of any consequence. Further, the compacted material is too hard to trowel by hand.

Grout thus placed in the joints forms such a perfect bond with the concrete of the pipe that when a cured joint is later broken open with a cold chisel, the break does not occur along the bonding line.

One of the most notable features of the process is the virtual elimination of the human equation. With conventional mortar joints, the bottom of the pipe for obvious reasons is always the portion of the joint that suffers. With the new method the bottom sector may be "shot" just as easily as any other portion of the joint and consequently one can expect equally good workmanship throughout the circumference. One can be sure, also, that the annular space is completely filled with mortar.

On this particular job, both bell-and-spigot and tongue-and-groove pipe are used. The tongue-and-groove pipe is constructed so that the ends of adjoining sections butt on the inside, with about a $\frac{3}{4}$-in. opening on the outside. This opening is filled and a rough collar is built around it with the grouting machine. The machine works equally well on either type of pipe.

Final joint tests

To test the actual watertightness of the joint, four sections of 36-in. pipe were jointed, stood on end and subjected to a 10-ft. head of water. No leakage was evident. In addition to this test, the writer has been through a section of the line which had been

backfilled and subjected to the natural ground water head. Here again no leakage appeared.

In short, the process has been so successful from every standpoint that in the future all sewers designed by this office will be jointed in this manner. Exactly what the final costs will be cannot be stated as this article is written. However, it is certain that the labor and material costs will be less for this type of joint than for the conventional mortar joint, primarily because of the additional speed that can be made.

The total costs on this job of course will be exactly what the contract provided. On future work, total cost will have to include some form of royalty on the machine, and this figure has not been set. In any event, the cost will not be excessive and because of the high quality of the joint and the practical elimination of chance, it is the writer's conviction that the jointing of sewer pipe is likely to be more or less revolutionized by this new process. Undoubtedly, a strong influence will be exerted on the design of pipe by this invention because as soon as this method comes to be widely used, pipe shapes are likely to be redesigned to fit more closely the requirements of the machine.

The general contract for this piece of work is held by the Valley Construction Company, Seattle. Burwell Bantz is city engineer of Tacoma, and work on the sewer system is carried out under the supervision of the writer.

Water Treatment at Yuma, Ariz. Aimed at Reduction of Silt Content

Experience with rather unusual water clarification problems was reported by C. G. Ekstrom, district manager, Arizona Edison Co., Inc., Yuma, Ariz. at the recent convention of the California section of The American Water Works Association.

Mr. Ekstrom stated that the water system at Yuma has always been operated by a private company despite several attempts toward municipal ownership, the latest of which was voted down three to one in 1941. With the Colorado River so close, the principal problem has been to get rid of excessive silt content. How much silt there is may be judged by the local comment that Colorado River water is "too thick to pour and too thin to plow." Perhaps a more accurate estimate could be based on the fact that desilting works of the All-American canal 18 miles upstream from Yuma are designed to remove 70,000 tons of silt from diverted water every 24 hours.

Prior to the construction of Boulder and Parker dams, the silt content of river water at Yuma ranged as high as 55,000 ppm. by weight.

The method of clarification at the outset was by means of settling basins. Early company schedules quoted rates on "settled water." The high turbidity, however, made it desirable to experiment with a coagulant, particularly after the demand reached such volume that there was not time enough for adequate clarification by settlement alone. The experiments were directed primarily to turbidity reduction with the objective of increasing plant capacity. No endeavor was made to simultaneously reduce hardness or change chemical characteristics.

Alum for clarification

Best results were obtained with aluminum sulphate applied at the rate of 143 lb. per million gallons treated, or 17 ppm., which is equivalent to 1.0 grain per gallon. It was found that the water had to be given a period of flocculation after chemical treatment. With a 15-min. flocculation period followed by one hour of sedimentation, turbidity was reduced from 96 to 9 ppm., or 91 percent.

After these tests it was decided to remodel the sedimentation basins to apply this treatment. This was accomplished in a 3½-month period at a cost of only $20,000 and, by reason of the shorter time then required for sedimentation, increased the plant capacity from about 4 to 6 mgd.

Treatment expense is rated as negligible because during the three summer months it is necessary to apply alum at the rate of only 1.0 grain per gallon, with lesser quantities during the winter period. During the year ending Aug. 31, 1946, 910 mg. of water, using 95,400 lb. of alum was treated for an average cost of $1.92 per mg.

Filtration is accomplished by slow sand filters with provision for continuous mechanical washing of the sand. Four units 25x410 ft. in plan are used and washing is accomplished by taking each of the units out of service successively for periods of 1½ hours.

Washing is still done by a now well-known machine patented in 1892 by Hiram W. Blaisdell who, in that year, was given a franchise to operate the Yuma water and electric system. The successful operation of Blaisdell's machine at that time in Yuma led to similar installations at such cities as Wilmington, Philadelphia and Montreal.

This machine consists of an inverted metal box about 4 ft. square in which is operated a revolving rake provided with hollow teeth through which water is forced under pressure. The assembly is supported from a framework that moves the box over the surface of the filter sand while a pump removes the sediment-laden water from the metal box at a rate slightly greater than that at which the revolving teeth supply it.

Two rate schedules

Water rates in Yuma have been revised downward six times since the present owners of the private water company took control from the predecessors in June 1935, stated Mr. Ekstrom. Water is now sold at two rates: the "general water schedule" applies to all commercial industrial users and to those domestic consumers who prefer it. Under this rate the monthly minimum charge is $1.85. This pays for 1,800 cu.ft. of water after which the charge is 8 cents per hundred cu.ft.

The "optional residential rate" allows 2,000 cu.ft. for a $2 minimum with 7 cents per hundred cu.ft. for the next 5,500 cu.ft. and 5 cents per hundred cu.ft. thereafter. Forty percent of the domestic users prefer the general rate.

Per capita domestic consumption in Yuma for the year ending August 1946 was 208 gal. per day. On peak days the consumption per capita sometimes exceeds 350 gal.

California Auto-Assembly Building Has Seismic and Solar Protection

***Contents in Brief**—Solutions to the problems of providing resistance to seismic forces and protection from direct rays of the sun were worked out in the design of a new Chevrolet assembly plant at Van Nuys, Calif. Foundation investigations led to the use of piles with lengths and capacities predetermined. Pile capacities determined by results of shear and friction tests on soil samples.*

DESIGN HIGHLIGHTS of a new Chevrolet assembly plant at Van Nuys, Calif., are the "sunshades", consisting of vertical louvers of lightweight concrete, and columns designed to take practically all the seismic forces. The plant serves as an example of the way structures in California must be designed to resist the horizontal forces induced by earthquakes; it also is reported to be the first large application of vertical louvres in this country to provide adequate light and ventilation without the glare and heat of direct sunlight. Such louvres have been used in South America to some extent.

The plant will be capable of producing 400 cars and trucks a day and will include an office building, garage, assembly building, parts building, car-loading building, acetylene-generating plant and miscellaneous small structures. The assembly building, largest of all, is 610 ft. by 800 ft. and two stories high. It includes all the features of interest and has a structural steel frame with metal deck roof, concrete floor construction, and exterior walls of exposed concrete and glass.

The northern half of the assembly building will be used by the Fisher Body Division and the southern half by Chevrolet final assembly. In the Fisher section, the finishing ovens and spring and cushion subassemblies are for the most part located upstairs. The main assembly line runs the length of the Chevrolet section, with storage of parts and subassemblies on either side. Heat and ventilation for the assembly building are distributed through ducts which lead from fan rooms located on the roof.

Vertical fixed louvers or "sunshades" of lightweight concrete protect the windows on the western side of all major buildings from the direct days of afternoon sunlight. During the morning working hours, the sun is high enough so that heat and glare is not bothersome. The afternoon sun presents a different problem and protection is desirable.

The louvers consist of overlapping wire-mesh reinforced concrete slabs some 2 ft. long, 7 ft. high and $1\frac{3}{4}$ in. thick, spaced about $10\frac{1}{2}$ in. on centers. Precast in special steel forms, the slabs were hoisted by block and tackle and inserted in slots in concrete frames that project outward from the side of the building (Fig. 1). They are set at an angle that would exclude the sum during the working hours of the longest day of the year.

Installation of fluorescent lighting in all buildings is provided to assure

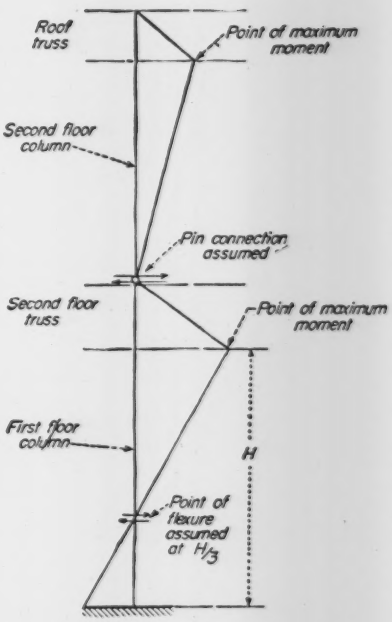


Fig. 2. Calculations of bending stresses due to seismic loads were based on the assumptions shown in the above moment diagram.

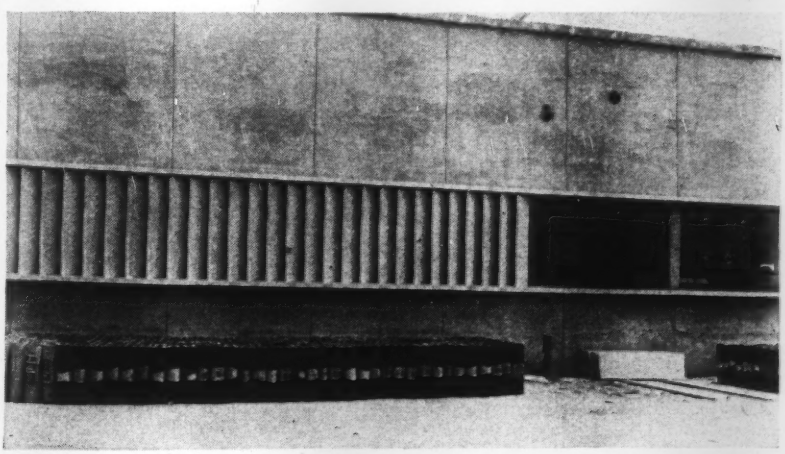


Fig. 1. To protect western windows from direct rays of the sun vertical louvers consisting of precast lightweight concrete slabs some 2 ft. by 7 ft. were installed in the new Van Nuys, Calif., Chevrolet assembly plant. Some louvers yet to be installed can be seen on the ground at the right.

ample level of light in working areas. This lighting will augment the natural light, which is reduced in intensity by the louvers. The combination of fluorescent lighting and louvers is intended to provide cooler and more comfortable working conditions.

Columns take seismic forces

Practically all seismic forces will be resisted by bending stresses in the columns, since vertical cross-bracing was possible only along the few permanent walls of the structure. Columns consist of H-beams varying in size according to location in the building and spaced 50 ft. on centers. The axes of alternate columns are turned through 90 deg. so that equal strength in bending is available in either north-south or east-west direction.

Second floor support is provided by steel trusses which span the 50 ft. between columns in both the north-south and east-west directions. A truss was chosen instead of using a very long and heavy beam.

Because of the great difference in seismic loading for the two stories, the first floor column is large as compared with the second floor column; all columns were spliced at the second floor level. The high stresses in the truss chords due to seismic loads also made a column splice at this point advisable. The splice was not designed to resist moments (1) because the splice detail would have projected above the floor and (2) because in this manner a pin connection at this joint could be assumed for design purposes, and the column stress analysis was simpler (Fig. 2).

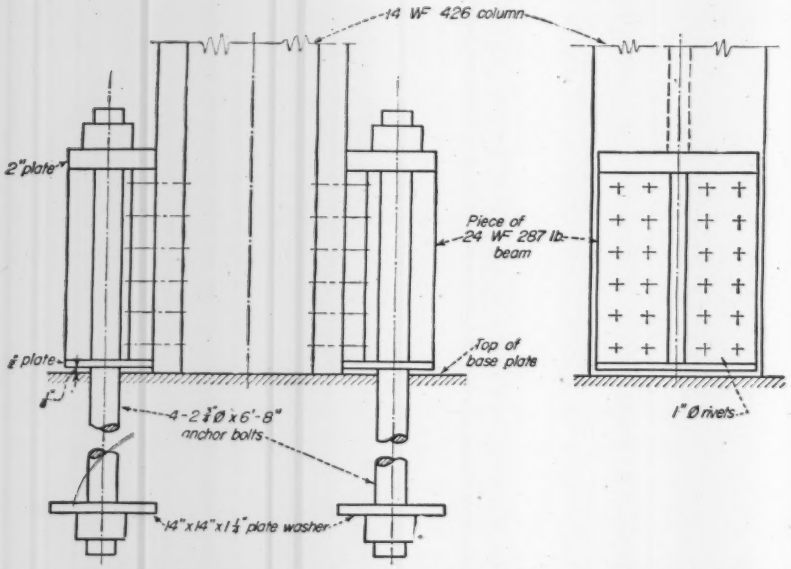


Fig. 3. This typical column base detail shows how this connection was designed to resist moments induced by horizontal forces. Sizes shown are for one of the heaviest base types used.

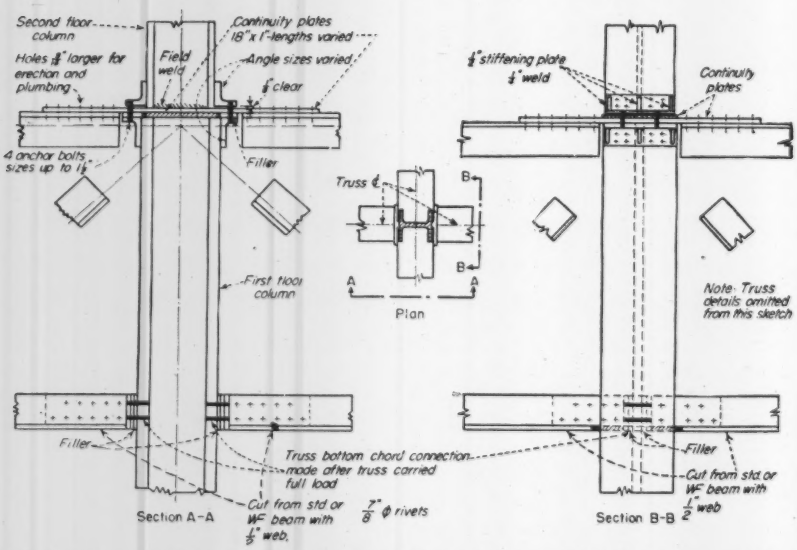

Second floor column
Holes ⅛" larger for erection and plumbing
Field weld
Continuity plates 18" x ℓ" lengths varied
Angle sizes varied
½" clear
4 anchor bolts sizes up to 1½
Filler
Truss
Plan
First floor column
½" stiffening plate ½" weld
Continuity plates
Note: Truss details omitted from this sketch
Filler
Truss bottom chord connection made after truss carried full load
Cut from std or WF beam with ½" web
⅞" Ø rivets
Section A-A
Filler
Cut from std or WF beam with ½ web
Section B-B

Fig. 4. The second floor column splice includes a connection between opposing trusses by use of continuity plates (required by high seismic stresses), which pass over the first floor column and under the second floor column.

Column base resists moments

To reduce the seismic moment in the columns, the column base connections were designed to resist moments, and a point of flexure was assumed to occur at one-third the clear first story height.

Moments are developed at the base of columns by means of anchor bolts cast in the concrete footings and attached to the columns by means of pieces of wide-flange sections. Wide-flange beams were cut in half through the center of the web and the flanges riveted to the column flanges. (Fig. 3).

A bearing plate is welded at top and bottom of each piece of wide-flange section and two anchor bolts bear on each top plate. These bolts vary in size up to 2¾ in. in diameter and to 6 ft. 8 in. in length. Space is left between the plate welded to the bottom of the wide flange sections and the column base plate so the bolt connection will act in tension only.

Because of the high stresses in the truss chords due to seismic loads, the second floor column and truss connections (Fig. 4) involve the use of continuity plates connecting the upper chords of opposing trusses. These plates pass over the top of the first floor columns and under the second floor columns. They were riveted to the trusses after erection, but lower-chord connections were not made until all dead loads were carried by the second floor trusses in

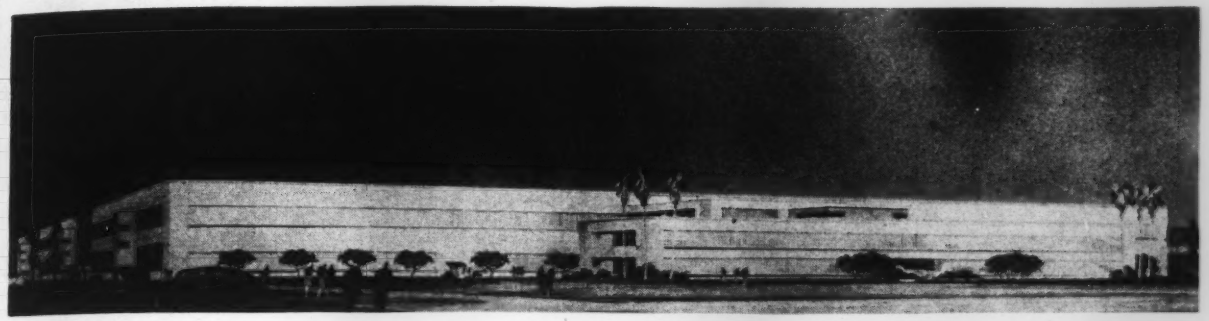


Fig. 5. Architect's rendering indicates how the Chevrolet assembly plant will look when viewed from the west.

order to minimize continuity stresses in this chord.

The soils underlying the site are alluvial deposits of relatively high compresibility, chiefly fine sandy loams, with occasional lenses of clay, sand and gravel, or silty loams. The water table is more than 100 ft. below ground surface. Such non-uniform subsurface conditions, together with the variation in types of buildings and loadings within each building, led to the making of extensive foundation investigations.

These investigations indicated that pile-supported footings could be used effectively. Therefore each column was placed on a concrete footing and some footings were carried by as many as fifteen piles. On the basis of relative cost studies made by the structural engineer, driven cast-in-place concrete piles were used for all columns loaded in excess of 150 kips and drilled cast-in-place piles carry column loads up to 150 kips. (Drilled cast-in-place piles as used here consist of 16-in. diameter uncased dry borings filled with concrete with nominal reinforcing.) In some cases both types of piles were used in a single building although under different footings.

Piles computed from test results

All the piles depend on friction and their capacities and lengths were computed in advance by application of a method based on the results of shear and friction tests on subsurface soil samples. This method is so conceived that no use is made of dynamic pile formulas (such as the *Engineering News* formula) either in designing or in computing capacities after driving. Driving records were kept to serve as an indication of any unexpected subsurface conditions.

An estimate was then made of the amount of settlement to be expected for various sizes of pile foundations in accordance with the results of consolidation tests. As a result, individual pile lengths of the larger clusters were increased to minimize future settlement. This increased the carrying capacity of the footing by increasing the surface area of the piles available to develop skin friction. However, because of the desire to make the settlement of heavily loaded footings comparable with that of the more lightly loaded portion of the structure, no reduction was made in the number of piles in a cluster.

Plans for the assembly plant were prepared for the Chevrolet Motor Division of General Motors Corps. by the architectural firm of Parkinson, Powelson, Briney, Bernard, and Woodford, successors to the late Donald B. Parkinson, architect. Joseph Sheffet was structural engineer for the architect. Albert Kahn, Associated Architects & Engineers, Inc., acted as consultant, as the overall pattern of the plant follows closely the Kahn-designed expansion of Chevrolet production facilities at Flint, Mich. Foundation investigations and analyses were made by Dames & Moore, foundation engineers.

States Make Large Appropriations For Emergency Housing

Five states have made multi-million dollar appropriations for emergency housing this year, with New Jersey the most recent addition to the list, according to the National Association of Housing Officials.

A $41,000,000 veterans' housing program was initiated in New Jersey when the recent special session of the state legislature passed measures appropriating $6,000,000 for immediate housing operations and providing for a $35,000,000 bond issue.

Housing accommodations of any sort, including ships, will be sought either for conversion or materials. Federal authorities will be solicited for vacant military housing units.

The bonds, if accepted by voters, will be issued as needed to finance the housing program and will be retired with alcoholic beverages taxes and half the pari-mutuel tax receipts.

New York, California, Connecticut and Ohio also have backed housing this year through large legislative appropriations. New York earmarked $35 million last spring for statewide housing projects, and more recently authorized an added $80 million for low-rent slum clearance projects.

Connecticut's legislature appropriated $5 million to be used in matching, on an equal basis, local government housing expenditures. Another $500,000 was earmarked as a revolving fund to purchase building materials for resale to municipalities.

California has earmarked $10,000,000 for housing aid to cities. The state will subsidize local programs up to 90 per cent of costs. Municipalities must put up at least 10 per cent. And Ohio legislators appropriated $6 million for housing allocated to counties.

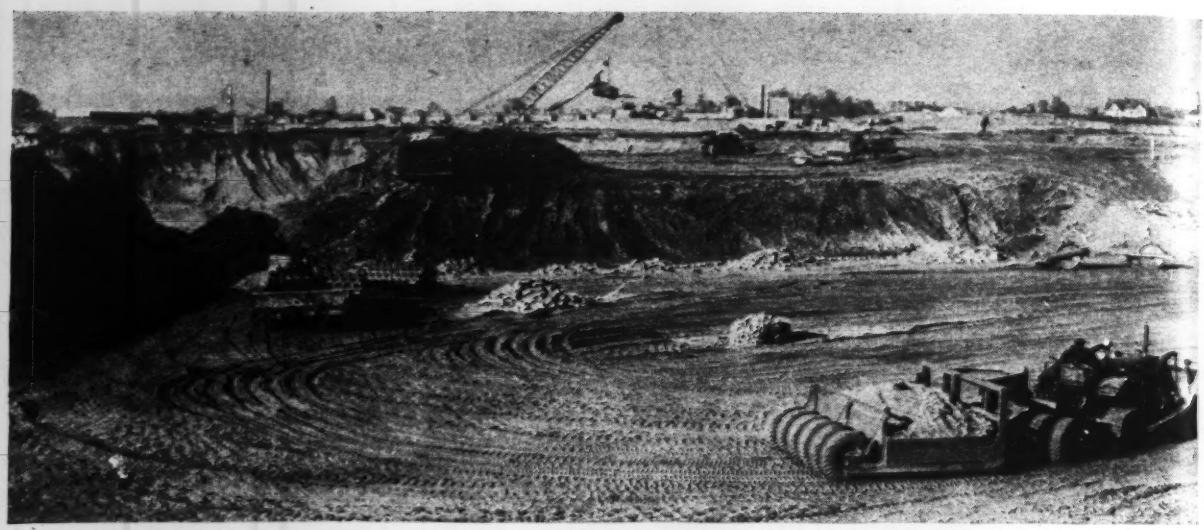


Fig. 1. Compacting fill in existing deep pits at runway locations on London's Heathrow Airport.

Runway Construction at London Airport

McGraw-Hill World News
London Bureau

***Contents in Brief**—Subsurface preparation for London's great new airport requires filling of old pits with compacted gravel or, when wet conditions demand, with a 1:14½ roller-compacted concrete. Surface is 12 in. of concrete, mixed in pavers set at a central location, with wet-mix hauled by truck to the forms where a mechanical spreader is followed by a tamping finisher. Full-depth expansion joints are held straight by casting an 18-in. wide strip of concrete across the lane just ahead of the general placing.*

A HUGE AIRPORT for London, being developed from the former Royal Air Force Transport Command base at Heathrow, 14 miles west of Charing Cross, is significant for inaugurating two important advances in British heavy construction—extreme mechanization and careful concrete control. Heathrow represents the most highly mechanized job of its kind ever undertaken in England, and the concrete produced is of much higher quality than was obtained by former British practice.

Work on the London Airport was started by the Royal Air Force with considerable equipment supplied by the U. S. Army. After the end of the war, construction was taken over by the Ministry of Civil Aviation, and the equipment was left for its use. From the beginning, the contractor on the work has been the well known George Wimpey & Co.

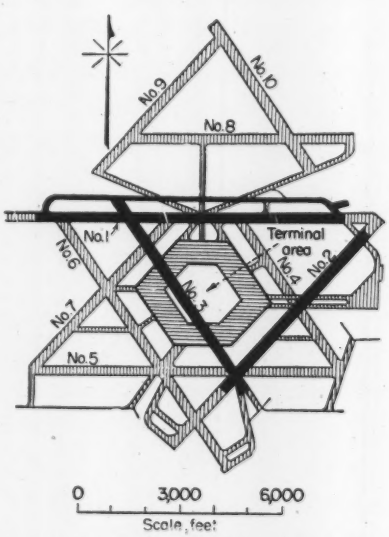


Fig. 2. Runways 1, 2 and 3 are in operation for lengths shown in solid lines.

Triangular runway systems

Heathrow airport is now in use in the first of three development stages that eventually will provide a 4,500-acre field with three triangular runway layouts. Two of these triangles intersect to form a parallel runway pattern, leaving a 65-acre center plot as a site for a deluxe terminal building. This construction, including the requisite taxiways, aprons and hangars, will encompass the present 1,500-acre site.

Runways are 250 to 300 ft. wide. The main east-west runway now 9,000 ft. long, can be extended to 15,000 ft., when necessary. The other two runways of the first triangle are each 6,000 ft. long, and can also be extended. A 100-ft. wide perimeter track runs the full length of the east-west strip and connects with a temporary arrival and departure area. At the start of operation of the airport in June accommodations and offices were largely in tents and trailers, but these are being displaced by temporary prefabricated buildings.

The second runway triangle, due to be completed in 1949 or 1950, will

require construction of four runways, as No. 3 will become inoperative, except for portions usable as taxiways, to clear the central terminal area. Work on this second phase of construction has begun with earthwork for the No. 4 runway, which will be 6,000 ft. long and 250 ft. wide. No. 5 and No. 6 runways will be 9,000 ft. long by 300 ft. wide, and No. 7 will be 6,000 ft. long.

It is expected that the permanent terminal building will be under construction by 1950 and will be reached by twin underground vehicular tunnels. A 2½-mile extension of the Picadilly subway line to the terminal is under consideration.

The last stage of the airport development, construction of the third runway triangle in the area to the north of the first and second stage construction, will not be undertaken before 1950 at the earliest.

Soil and sub-base problems

While ideal from an accessibility standpoint, the area selected has both liabilities and assets as a construction site. Difference in elevation across the site is only 6 ft. The subsoil is gravel which, when carefully compacted, has proved ideal as a subbase for runways designed to take the heaviest aircraft of the foreseeable future. The site is covered by 6 in. of top soil and an average of 2 to 4 ft. of what is known in England as brick earth.

The one serious construction difficulty is caused by the presence of some 70 acres of worked gravel pits, filled with water and a sediment of slimy silt. Altogether, some 120 acres in area have to be reclaimed as a result of the old gravel workings, about 15 percent of which is in the runway areas. Use of large earthmoving and compacting equipment, Fig. 1, on a scale never before undertaken by the British, permitted start of use of the field in only a fraction of the time such projects have previously required.

To provide a sub-base of high-bearing capacity the top soil and brick earth were removed, and refilling accomplished to the original level with gravel from borrowpits on the site. Gravel was laid in 9-in. layers, each layer being thoroughly compacted by sheepsfoot rolling followed by rubbertired rolling to required density.

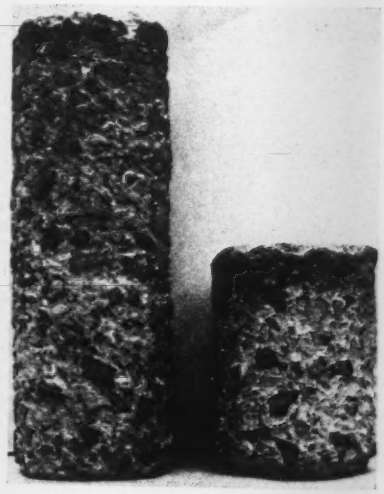


Fig. 3. Cores from roller-compacted (left) and finisher-compacted 1:14½ concrete used as fill.

Borrowpits opened were between projected paved areas at a safe distance from any possible overrun by aircraft. In effect, only a transfer of material took place as the gravel was replaced by the excavated brick earth.

In some areas it was necessary to consolidate gravel fill up to a depth of 22 ft. in the abandoned gravel pits. Water was readily pumped from the pits, but the tremendous volume of silt, deposited as a result of many years of screening concrete aggregates, was too abrasive to be removed by available pumps. Silt was excavated by machine down to the underlying London blue clay, and the holes refilled with 9-in. layers of selected gravel in the same way as that for the level areas of the field. Outside the paved area the pits were used as receptacle for surplus excavation of all kinds, and the fill was not consolidated.

During the late fall of 1945 and early 1946 an unusually wet season threatened serious interruption in laying the sub-base for the main runway since the gravel could not be compacted when wet. To speed operations, a fill of dry, lean concrete (14½ parts of pit-run gravel to one part of cement by weight) was power-rolled in 9-in. layers. Water-cement ratio was maintained at 0.6, and 28-day compressive strengths of 3,500 psi. were obtained. Where concrete of the same mix was compacted by finishing machine, a water-cement ratio of 1.0 was required for workability with resulting 28-day strength of 1,800 psi.

Basic design details

Runways and taxiways were designed to take up to 160-ton aircraft (today's heaviest is 40 tons). Paving over the carefully prepared sub-base is 12-in. thick, 4,000-psi. concrete, with no reinforcing.

Concrete was laid in 20-ft. lanes with 1-in. wide expansion joints used both ways in the slab. Longitudinally, expansion joints are at the centerline and 60 ft. on either side

Fig. 4. When continued rains delayed compaction of gravel fill a lean (1:14½) concrete was used for sub-base fill and compacted by rolling.

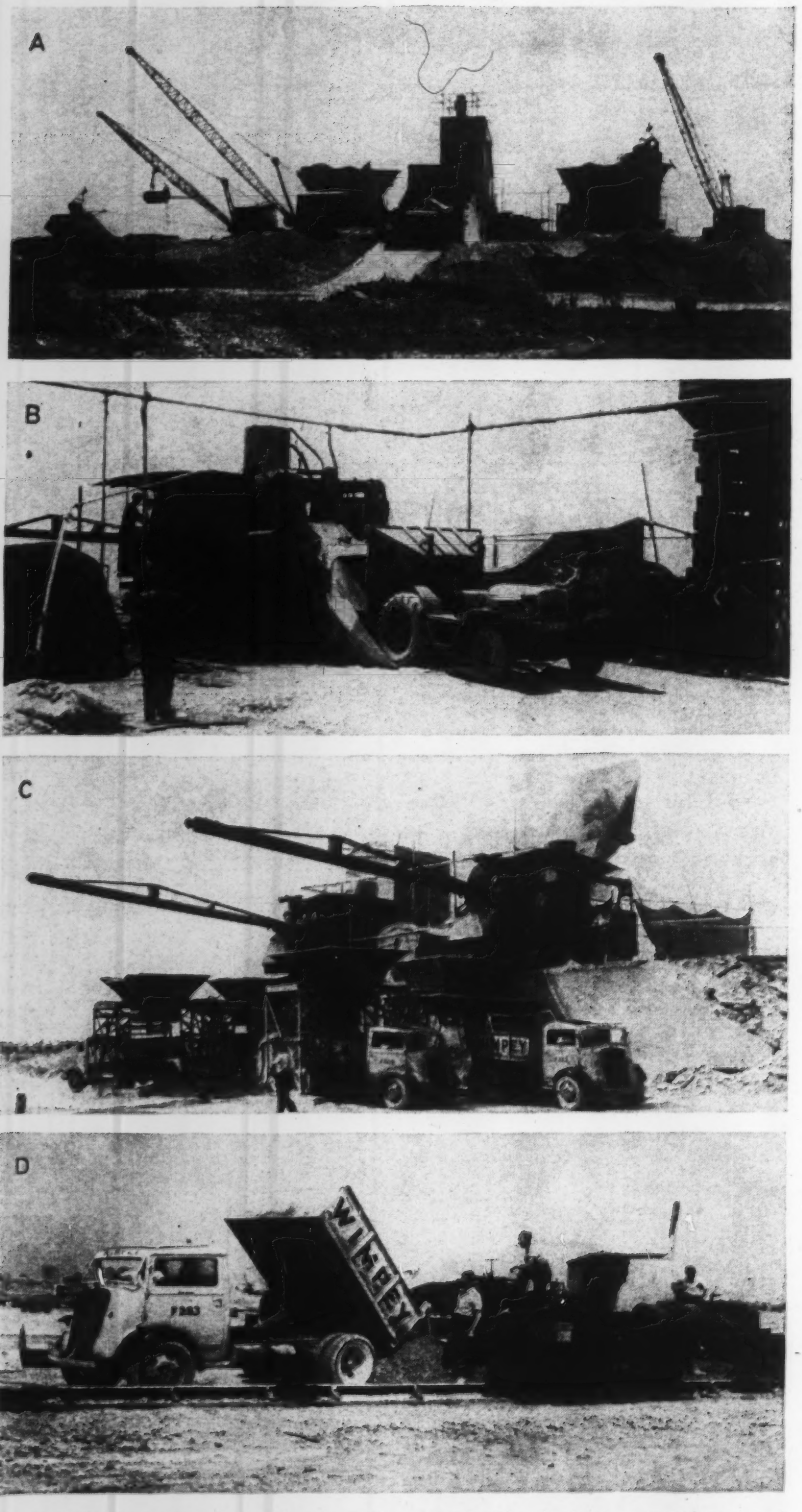


Fig. 5. (A) Cranes feed sand and small gravel to bin at right and two sizes of larger gravel to bin at left while cement delivered by truck, is raised by bucket elevator to bin in middle. (B) Motor dumpers pick up a part of batch at each of three bins and deliver to skip of pavers on parapet. (C) Pavers dump concrete into hoppers that feed two wet batches to a truck for a haul to the lane being paved where (D) concrete is spread by mechanical means.

of it; transversely, the joints are at 120-ft. centers. In addition, there are transverse contraction joints, ¾ in. wide and 4-in. deep, at 20-ft. centers. Along construction joints a narrow slot 1½ in. deep is formed to take sealing material.

Runways have a straight slope of 1 to 200 each way from the centerline, making a 9-in. difference in elevation to the outside lane, which is dished upward 3 in. to make a runoff channel. Taxiways also slope 9 in., but in this case only one way for their full width and, again, the outside lane is dished 2½ in. to carry surface drainage.

Open grating catch basins are located at 75-ft. intervals along the outside lane of the pavement, and 6-in. cross-connected drains lead to main stormwater collector drains 15 ft. from the edge of the paving. The collector drains run into a main outfall, which consists of four 54-in. dia. pipes that empty into an old gravel pit used as a balancing reservoir.

The balancing reservoir eliminates risk of creating flood conditions in the small River Crane nearby as a result of high runoff from the extensive surfaced area. Outflow from the reservoir is controlled, and a concrete oil-retention weir traps oil and other impurities likely to contaminate surrounding water courses. Two additional outfall reservoirs will be required to handle the calculated outflow for the total paved area of the completed project.

Concreting practice

Mixing and placing of concrete was controlled and mechanized beyond previous practice in Britain, but the methods used, except for a few details, are not new to American construction. For example, the weigh-batching of aggregates and the close control of gradation by separation and batching of gravel in three sizes are innovations there but common practice here.

Two separate concrete plants were set up for paving the airport. One plant used two non-tilting mixers directly under aggregate bins, which are fed by cranes while cement is raised by bucket elevator. Concrete is distributed by tip lorries—dump trucks in U. S. language.

The other plant, Fig. 5, used two separate bins for four sizes of aggre-

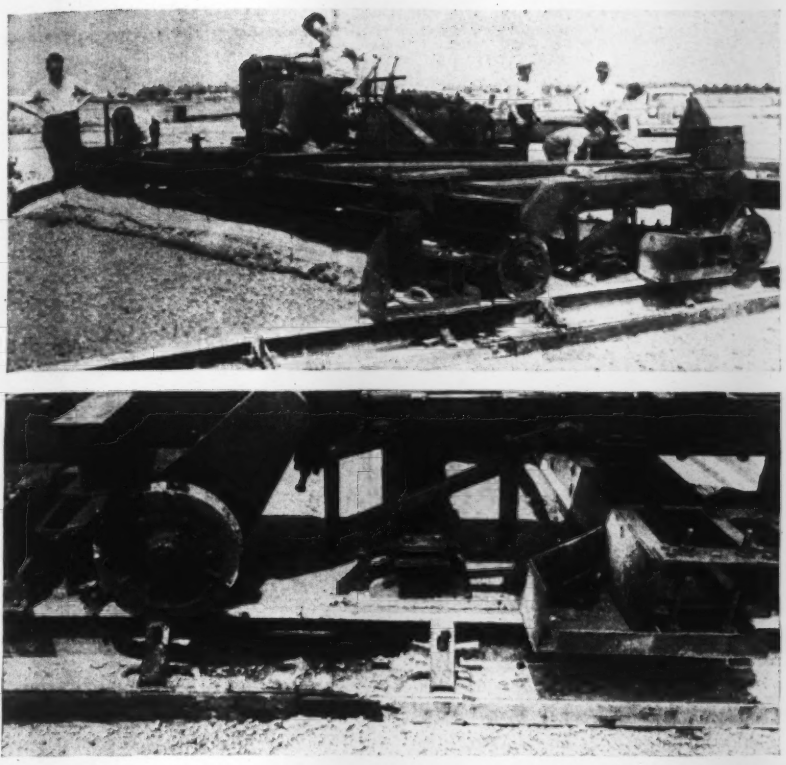


Fig. 6. Following the spreader a machine with a front screed, tamping bar (shown in the close-up below) and a rear screed complete the mechanical finishing.

gate plus a cement bin under which motor dumpers were driven to collect, in three stops, a 37-cu.-ft. batch of aggregate and cement for delivery to either of two 34-E double-drum pavers, set up for the duration of the job at a point near the plant. The pavers discharged, via the regular buckets, into "wet hoppers" used to load two batches into 4 cu. yd. dump trucks for haul to the forms.

Details of mix

Coarse aggregate was gravel with a maximum size of 1½-in., and was separated into material retained on ¾-in., ⅜-in., and 3/16-in. screens. Fine aggregate was sand well graded from 3/16 in. down. The mix selected after trial was 1:2.23:3.97 of cement, sand and gravel, respectively, with 0.49 parts of water. The 3.97 parts of coarse aggregate was made up of 1.92 of ¾ in., 1.35 of ⅜ in. and 0.70 of 3/16 in. material. The concrete was mixed for 35 sec. in each drum of the pavers.

Unusually close control of concrete materials and placing was exercised throughout the construction period. Concrete paved areas were provided for aggregate storage to facilitate drainage. Materials were required to have at least 12 hr. storage before use, accomplished by providing for two piles of each size—separated by an 18-in. thick brick wall. Sand was generally taken from only the top of the pile, avoiding the wet material at the bottom.

Fig. 7. Expansion joint is aligned by placing against one form set for pouring an 18-in. wide transverse strip. Concrete is compacted with vibrators.

Moisture determination by pycnometer was abandoned in favor of more accurate results from drying by heat and weighing. Coarse aggregate was found to have a quite constant moisture content at 0.5 percent for ¾ in., 1.4 for ⅜ in., and 2.9 for 3/16 in. material and these values were used with only occasional checking. Moisture in the sand was determined four times daily but the engineers commented that these values could be used only as a guide for the inspector to determine the water content on the basis of workability.

The slump was held to ¾-in. or less with resulting concrete strengths of about 4,250 psi. at 7 days, 6,300 psi. at 28 days and 8,250 psi. at 90 days. Minimum strength requirement was 4,000 psi. at 28 days which was exceeded by practically all test cylinders.

Tamping and vibration used

Steel forms 8 in. high with 4 in. timbers bolted to the bottoms were used along the edge of the 12-in. slab for each of the 20-ft. wide lanes. Where lean concrete had been used for the sub-base the holes for form pins had to be made with pneumatic drills. The 2¾ cu. yd. of concrete in each truck load was dumped in a pile and distributed to 1 in. above the desired grade by a powered blade-type concrete spreader, operating on the forms or with one or both ends on previously placed concrete.

A finishing and compacting machine followed the spreader with the front screeding beam set at 1 in. above the required finished concrete. An eccentric cam type of vibrating beam, operating at 3,000 cycles per min., compacted the concrete while final leveling was provided by a second screen on the same machine set at the finish level. The spreader and the screen compacting machine are new to British concreting practice.

Flexible-shaft immersion vibrators are used along the edges of the lane, just ahead of the finisher. For the outside lanes, a hand-held vibrator the width of the lane, compacted the concrete to the depressed surface shape required. Finally a canvas belt was used transversely to leave a smooth surface for landing wheels.

The method used to set transverse

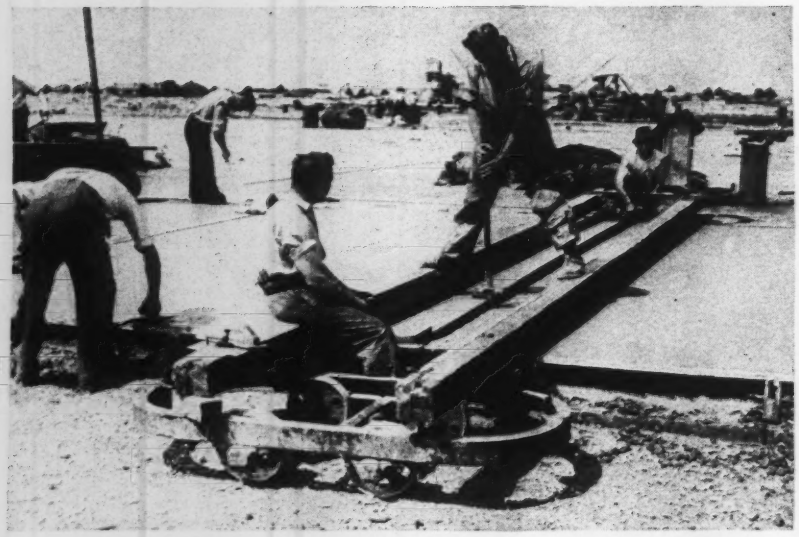


Fig. 8. Contraction joints were formed by forcing a 4 in. by ⅜ in. steel strip into the concrete until its top was flush.

expansion material is not common to U. S. operation. Two lines of forms were set transversely across the lane and 18-in apart just ahead of the required location. Then 1 in. of expansion material was placed against the side from which the concreting operation was approaching. Concrete was shoveled by hand into the forms in two 6-in. layers and compacted by a pan-type vibrator, Fig. 7. As the concreting operation reached the joint the forms were removed and concrete placed against the still "green" material. Full bond was attained with no plane of weakness.

Concrete was cured by spraying with bituminous emulsion within ½ hr. after laying; when the surface had hardened it was covered with a double thickness of hessian (burlap), which was kept wet for four days. The reason advanced for keeping the surface moist in addition to the bituminous coating was to hold the temperature of the setting concrete as low as possible to reduce the rate of hardening and the temperature change. Also, it was expected to prevent evaporation of water from the concrete that might occur through the film of bitumen. Hauling over the finished slabs was permitted after seven days, and the work was planned to take advantage of this.

The Air Ministry Works Directorate has continued to direct construction work at London Airport even though the field is now under the control of the Ministry of Civil Aviation. Joseph G. Colquhoun has been chief resident engineer of the project since its inception. George Graham is resident concrete engineer for the project and Mr. Colquhoun's deputy.

Kutter Formula Favored in Aqueduct Tests

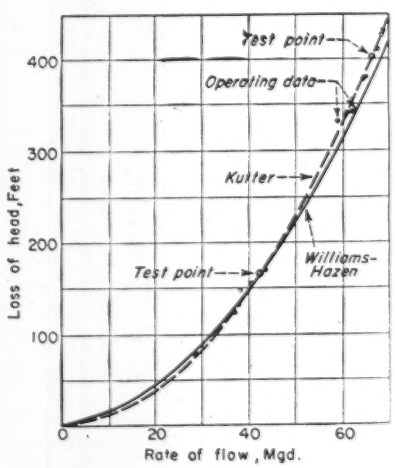
THE KUTTER formula is the most suitable formula for determining friction losses in aqueduct flow, according to tests engineers of the East Bay Municipal Utility District, Oakland, Calif., made on the district's Mokelumne aqueduct. As the result of these tests, the Kutter formula was used for computations in connection with the design of aqueduct improvements.

Various friction-loss formulas were computed, based on the results of a test during which the aqueduct flow was 42.46 mgd. (see curves). A similar test was then run at 66.2 mgd., the computed results fitting the Kutter formula. Random points plotted from operating records verified conclusions reached by the second test.

Tests were made by the color-velocity method as follows: During an aqueduct shutdown, the interior of the section of line to be tested was measured accurately. Then, with the aqueduct delivering at a constant rate, potassium permanganate was introduced into the measured section. At various downstream points readings of a turbidity meter and a stop watch were taken on microfilm at regular intervals. Thus, the time necessary for the maximum turbidity caused by injection of the potassium permanganate to reach each measuring point was recorded and the velocity thereby determined. The flow in the aqueduct being relatively slow (about 7 ft. per sec.), only one set of instruments was required as they could be moved fast enough to keep up with the flow.

The Kutter formula was recently used to design pumping facilities to increase the flow in the aqueduct (*ENR* Sept. 5, vol. p. 310). Operating results of the system since the installation of the new equipment have further verified the use of this formula.

Tests were made under the supervision of H. A. Knudson, chief mechanical and electrical engineer, East Bay Municipal Utility District, Oakland, Calif.



Friction-loss curves for flow in the Mokelumne aqueduct of the East Bay Municipal Utility District were taken to indicate the Kutter formula as preferable for computing head loss in long aqueducts.

Right to Extinguish Highway Access Upheld by Minnesota Courts

***Editor's Note**—Have highway officials, under the basic highway laws of states, the authority to curtail or extinguish access of abutting property to roads designed as freeways? A decision of the Minnesota Supreme Court, handed down May 18, 1945, asserts this authority. The decision applies only to the Minnesota road laws as within. It was also dissented from in the opinion of one of the justices. Standing, however, as the first high-court pronouncement on the point at issue, the Minnesota decision is of vital interest to highway administrators and legal counsel. A brief summary follows for general information; for argument and citation on the fine legal points concerned the full decision should be studied.*

A DECISION of the Minnesota Supreme Court upholds the authority of the state highway commissioner to extinguish the right of access of property adjoining a highway. The decision takes on the forces of general application although rendered in a specific case of appeal from a district court adjudgment. It extends to all highways of the state although rendered in the case of a specific highway designated as a "freeway." Specifically also, the decision applies only to the general trunk highway system law of Minnesota.

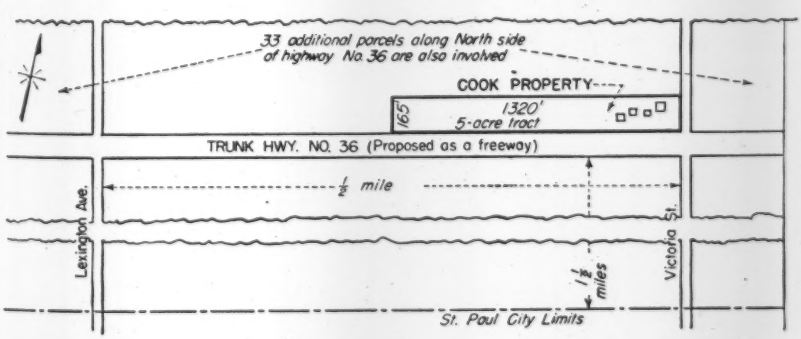
As the first pronouncement by a high court conferring such broad power on state highway administrations, without special legislation, interest in the Minnesota verdict extends to the highway departments of all states. Are the basic highway laws under which states have developed trunk road systems inclusive of authority to curtail or extinguish right of access necessary for "freeway" construction? In reply the Minnesota decision, with its strong dissenting opinion, offers important testimony. Of the text, extending to some 20,000 words, the case facts, the verdict and short summations of the supporting and dissenting opinions follow. To avoid unfamiliar legal terms and interspersed documentation the decision text is freely rendered. The case is known as Minnesota vs. Cook (19 N.W. (2nd) 395, May, 1945).

The case facts

The accompanying diagram indicates the highway and the adjoining properties that are concerned. The highway is designated a limited-access highway (freeway) by the state highway commissioner, with access only at established highway intersections. The land extends about 1,320 ft. along the freeway and fronts about 165 ft., on Victoria St., just outside the city limits of St. Paul. For about 300 ft. in from Victoria St. the land is improved by the owner's home and appurtenances for a trailer camp. The remaining about 1,000 ft. is vacant land but is held of value for future subdivision and sale. With access to the freeway denied its only access to a highway will be by the construction of a road from Victoria St. through the owner's home lot and to and through the vacant area of about 3½ acres.

Commissioners appointed by the court awarded the owner $300 damages for extinguishment of the easement of access to the freeway. This pre-trial offer was refused as inadequate and the state began legal proceedings to acquire by condemnation easement of ingress to and egress from the freeway. On trial, the district court handed down judgment for the state authorizing such condemnation.

The question of monetary damage to the owner was submitted to a jury which found that no damage had been sustained. An appeal from this judgment was carried to the state supreme court and it is its findings and arguments that are developed.



Plan of the property near St. Paul held subject to extinguishment of the right of access by Minnesota Supreme Court decision.

Verdict in brief

On appeal the contentions were: (1) The easements of ingress and egress are not subject to condemnation; (2) the commissioner of highways under the Minnesota constitution and statutes lacks power to condemn such easements, and (3) the verdict of no damages is entirely inadequate and contrary to undisputed evidence.

In answer to these contentions the verdict of the court, with one justice dissenting as related later, was in brief as follows:

1. An abutting property owner's right of access to a public highway is an interest in land and an incident to the owner-

ship thereof, subject to condemnation under the law of eminent domain, which may be taken thereunder for public use by the state in its sovereign capacity upon payment of proper compensation to the owner.
2. The commissioner of highways by virtue of the power delegated to him by the legislature of the state is authorized to acquire by purchase, gift or condemnation, on behalf of the state, all right-of-way needed in laying out and constructing the state highway system and so much as shall be necessary for the proper and safe maintenance thereof. Under this statute said commissioner has the obligation of maintaining the highways, free from traffic hazards wherever possible, and hence the power to extinguish easements of access thereto in order to establish "freeway" highways to meet increasing traffic demands. *Held*, under such statutory authority, that the commissioner had the right to acquire appellant's right of access to trunk highway No. 36 [the freeway in question] for the purpose of making it a "freeway" highway.
3. The undisputed evidence disclosing that appellant as owner of the land abutting on trunk highway No. 36 will suffer damages by the taking of right of access thereto, the jury's verdict awarding no damages therefor is contrary to such evidence and necessitates the granting of a new trial on the issue of damages.

As stated, a dissenting opinion was recorded. The argument in this case therefore divides into two parts. Contention both for and against, including citations of court decisions, extend to too great lengths for possible inclusion here. Only statements of summation are given.

Supporting argument

Except as its power is qualified by constitutional limitations, the state as an atribute of its sovereignty has the power to extinguish private property rights. The state constitution provides that private property shall not be taken, destroyed or damaged for public use without just compensation therefor, first paid or secured. An easement of access to a public highway is a property right, to which the highway is servient, and may be extinguished by the state under eminent domain when the taking is for a public purpose and when proper compensation is paid the owner. Eminent domain permits not only the taking of easements in land, including the right of access, but also, if rightly exercised and upon payment of proper compensations, it permits the complete vacation of roads and streets which in many instances deprive the landowner of his easements of access thereto.

The state legislature by statute has delegated to the commissioner of highways powers in these terms:

The commissioner of highways is empowered to carry out the provisions of the Constitution of the State of Minnesota, and is hereby authorized to acquire by purchase, gift or condemnation, as provided by statute, all necessary right-of-way needed in laying out and constructing the trunk highway system, and to locate, construct, reconstruct, improve and maintain such trunk highway system.

In its authority to reconstruct, improve and maintain highways, the Minnesota statute grants much broader powers than do the statutes of most states.

While it is true that a number of states have passed acts for the public control of highway access, in many of such states the highway commissioner did not possess the broad statutory power granted him under the Minnesota act, not only to acquire the necessary land for highways, but also to operate and maintain them after their construction, and, if necessary to reconstruct them. While special legislation may be helpful, certainly it is not vital or essential to the objective sought here nor should the fact that some other states have enacted special legislation be urged as authority for holding that special laws are advisable here before the highway commissioner can extinguish easements of access or create limited-access highways under the broad language of the Minnesota statute.

The authorities are almost countless that hold that easement of access must not be taken unless compensation is paid and which, by implication, indicate that such easements may be taken when the owners are compensated therefor. A few authorities have been cited where the right has been properly denied. These are cases where the state has acted under its police power and attempted to take without payment of compensation. Not a single authority has been cited which denies the state or its departments under the power of eminent domain the right to extinguish such easements on payment of just compensation.

Dissenting argument

Dissent from the verdict rendered is upon the sole ground that the commissioner of highways is not authorized by law to acquire by condemnation an owner's right of access to an established highway. The Minnesota statute authorizes the highway commissioner "to acquire by condemnation as provided by statute all necessary right-of-way." The phrase right-of-way in connection with roads and highways means a strip of ground of specified width on which a highway or a roadbed is constructed, and no interpretation of the law has indicated any other meaning.

The statute conferring the right of eminent domain on the commissioner of highways was enacted long before limited-access highways were ever thought of. Roads were laid out and constructed primarily for the benefit of adjoining land owners. The great object of the trunk highway system was to make accessible to the people a system of improved roads. As the proponents of the system said, the purpose was to get the farmers out of the mud. To the extent that the commissioner can exercise the power asserted he not only can keep them in the mud but off the highways altogether.

Law definitely limiting

The legislature has made no such wholesale delegation of power as that. It has granted limited and carefully defined power. It has carefully discriminated between right-of-way, additional right-of-way and easements outside the right-of-way. A review of the legislation proves this.

In the general highway act, the commissioner was granted power to secure right-of-way only. Counties and towns were granted the power to acquire right-of-way of specified width [four rods or 66 ft.] and "additional right-of-way" for construction and maintenance. Then piecemeal, they were granted by subsequent statutes the right to acquire additional right-of-way for purposes of safety of public travel. Later, both the commissioner and county and town officials were given for the first time the power to acquire an easement of any sort and that was limited to one for snow fences.

The legislature has made it clear that right-of-way may be acquired for safety purposes but not easements in property lying outside the right-of-way by granting the commissioner

practically unlimited power to acquire right-of-way and none to acquire easements except for snow fences, and by granting to county and town boards specific power to acquire additional right-of-way for safety purposes but not easements for such purposes.

Question of legislative intent

There is then the inference of legislative intent in respect to right of access. Long prior to the enactment of the Minnesota statute defining the powers and duties of the highway commissioner, the eminent domain statute was constructed by the state supreme court as "a court of last resort" and it was held that the taking of a right-of-way for a street simultaneously creates in the abutting owner a right of access thereto. Under the statutory rule of construction, when a court of last resort has construed the language of a law, the legislature in subsequent laws on the same subject intends the same meaning to be placed upon such language. Therefore, in the statute being discussed, the legislature must have intended that a taking by the commissioner should at the same time create a right of access in the adjoining property. A power whose exercise was intended to create a right, cannot be used to take it away.

In conclusion said the dissenting judge, this is a case where the legislature, if the power asserted by the verdict is to be exercised, should speak in the light of changed conditions. It should determine whether the highway executive shall have the right to take the abutting owner's right of access at all. It should say whether, if granted, the power shall be limited to new highways or shall extend to all highways. It should say whether the power should be limited to certain types of roads, and if so to which ones. It should prescribe distances for which access may be denied, and establish other determinations which may be needed.

Self-Sufficient Pipe Trailer Gives Pick-up and Delivery Service

Steel pipe 70 I.D. of $\frac{3}{8}$ to $\frac{1}{2}$ in. plate was economically moved into the trailer unit shown by the cable-operated monorail operating on the I-beam along the top of the cradle. The large diameter pipe was arc-welded at a central yard and the metal surfaces cleaned by grinding wheel and shot-blast. Interior surfaces were covered with a protective coating of hot coal-tar enamel and the exterior surfaces coated with $\frac{3}{4}$ in. air-applied portland cement mortar reinforced by wire mesh. Bituminous sealing and curing compound was sprayed on the mortar while it was still moist.

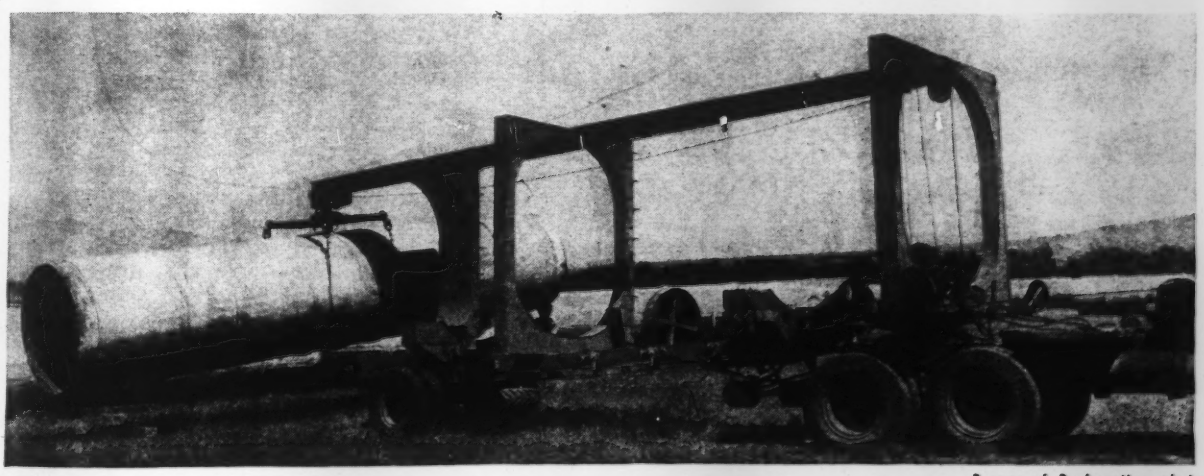
Fabrication of the plate-steel pipe was done by the Utah Construction Co. From their yard C. B. Warren hauled the pipe to the field on the trailer rig shown, laying it out along the line where it was put in place by a crane. Steel joints were electric-arc welded and finished with enamel and mortar coatings to match the other parts of the pipe line. The enamel and mortar coatings are expected to provide permanent protection for the pipe.

For transporting, the trailer rig was self-sufficient with a small power winch rigged to operate the cable that lifts the pipe and moves it end-wise into the padded cradle. Hand powers are available for use if the mechanical hoist fails.

Part of Provo Project

The pipe line is a part of the Salt Lake City Aqueduct being constructed as part of the Provo River Project of the Bureau of Reclamation. The greater part of the aqueduct is constructed of precast reinforced concrete pipe with the plate steel used in sections where high pressures must be resisted.

Information on the pipe handling was supplied by L. R. Dunkley, project engineer for the Bureau of Reclamation.



Bureau of Reclamation photo

Designed to handle 70 in. I.D. 30-ft. long pipe on or off the trailer used for transport, this monorail hoist lifts the pipe and moves it end-wise into padded cradle.

Comment and Discussion

Readers' opinions on matters that concern engineers and contractors

Plate Theory Explains Curling

Sir: In the interesting article on "Practical Methods to Avoid Cracked Walls," by T. H. McKaig, (*ENR* Oct. 17) the cracking of brick walls that support flat concrete floors is mentioned and it is suggested that various reasons have been advanced for this "curling" effect.

There is, of course, only one correct explanation and it is to be readily found in the natural behavior of a rectangular flat-plate simply supported around its perimeter. The theory of flat-plates shows that for a uniformly loaded plate the corners tend to lift from the supports. This phenomenon is well known by those familiar with the theory of elasticity. In fact, in Timoshenko's "Theory of Plates and Shells," the author states (p. 116), "It may be seen that the corners of the plate have a tendency to rise up under the action of the applied load and that concentrated forces R (downward) must be applied to prevent this".

From this it will be seen that, unless the wall or column loads from above at the corners of a flat concrete floor are sufficient to press the corner down, the corners of the plate should be anchored down with vertical reinforcing rods if the cracks mentioned in the article are to be prevented.

I. F. MORRISON
Professor of Applied Mechanics
University of Alberta—Edmonton

The Balloon Frame—A Tribute

Sir: The tests of balloon-frame timber walls described in *Engineering News-Record* Oct. 17, p. 117 mark almost to a year the one-hundredth anniversary of the first balloon-frame houses built by George W. Snow a Chicago builder of the 1840's. Precision of date is impossible but the year was 1845 or 1846. In the tests described the engineers of the Forest Products Laboratory probably had no thought of commemorating an event; the purpose was to add greater precision to the method of timber framing most used today and for the past one hundred years. Yet the event is worth tribute. With his balloon frame, George W. Snow, in 1845 fundamentally altered the ancient craft of carpentry.

As Chicago editor of *Engineering News* in 1895, the writer somehow lighted on the information that the balloon frame originated in Chicago. An article was written but the idea that a carpentry invention could be called engineering did not appeal to the chief editors. The desire to tell the story has always remained. Now, perhaps, that the invention of George W. Snow has reached a full hundred years of continuous use and at this ripe age commands the interests of engineering research the occasion has arrived. But the story is different.

Pittsfield Building, Chicago, site of pioneer wood frame houses.

This story starts with a picture of a building. It is the Pittsfield Building on the southeast corner of Wabash Ave. and Washington St. in Chicago. It is not the latest or the highest of Chicago's tall buildings but it is an excellent example of the principle of building construction given to the world by Chicago architect-engineers of the 1880's. It embodies an epochal invention in building.

On the site of the Pittsfield Building a hundred years ago almost exactly were built two two-story wood houses. There is no picture to show these houses. The mind, however, requires no picture to vision the contrast in size of these timber cottages of old Chicago and the present steel and masonry structure rising 557 ft. above the street with its foundations on bed rock 105 ft. below the street. Yet the wood houses embodied a new principle in framing that was to spread from Chicago to every corner of America. These houses were the first or very nearly the first balloon-frame buildings. They represented another epochal Chicago invention in building.

The balloon frame was a product of the Chicago building boom of 1845-1855. In 1845 Chicago had a population of about 8,000; in 1855 it was a city of nearly 85,000 people. To house the businesses and families of this rapid accession of citizens required a speed of building beyond precedent. The city developed closely contiguous to the main stem of the Chicago River on a sodden prairie only two or three feet above river level. The soil was a foot of swamp loam on three or four feet of quicksand overlying a dense clay. Foundations that required excavation and cellars were impracticable.

No construction ever satisfied a local requirement more perfectly than did the balloon frame. Posts or short piles driven through the soft soil to the clay gave quick and ample support. The material was lumber in its most available shapes of boards, scantling, lathing and

shingles. There was scarcely a stick that could not be erected by hand and usually by one man. Nailed connections did away with slow and skilled frame jointry. Every factor contributed to fast construction. The finished building was rigid and light.

It is generally agreed that the idea of the steel skeleton supporting walls and floors originated with William L. Jenney and the Home Insurance Building in Chicago in 1883-5. The invention and development of the balloon frame were the joint work of George W. Snow and John M. Van Osdel, equally famous Chicago builders of the mid-1800's. Precision in awarding personnel credit for invention, however, is less important than recognition that the steel skeleton and the balloon frame, marking epochs in building history, were both of Chicago origin, and from Chicago they have spread over the Americas.

Tribute here is paid to the balloon frame. The giant skyscrapers of Wall St., Rockefeller Center, The Chicago Loop, and scores of other places flaunt the principle of the wall-bearing steel frame in every man's face. It is only by account of the millions of little balloon frame buildings that have been the homes and places of work of the people through a hundred years that the dimensions of the new carpentry invention of 1845 towers into notice. Speaking of it in his autobiography, Henry Ericson, builder of the historic Monon and Manhattan buildings, of the Pittsfield Building, illustrated here, and of half a score more of Chicago's modern skyscrapers, says:

"The high points of Chicago buildings are rich in sky-written symbolism. The sign of the Cross; the Spirit of Progress; a Beacon to guide to their port ships that pass through the night sky, the ever bountiful Ceres—these combine to write a rich symbolism against our sky."

"Yet there is lacking a symbol of the invention without which the building of Chicago must remain scarcely understandable. To be true to its history, Chicago should have a tower carrying as high as Ceres, the figure of a carpenter holding up to the sky a scantling of white pine. That carpenter might well have been put atop the Pittsfield Building on whose site had stood two balloon-frame houses embodying an invention more important in the building of the nation than the steel frame which gave us our skyscrapers."

With this tribute, the conviction of fifty years ago that a carpentry invention could be true engineering seems not too absurd.

C. S. HILL
Associate Editor (retired)
Engineering News-Record

Bidding for Engineering

Sir: *Engineering News-Record* of Nov. 14, 1946 carried a news item entitled "Protest Idaho Engineering Contract." Some of your readers might read into that article an implication that Consoer, Townsend & Associates make a practice of bidding competitively for engineering work. Such is not our policy.

As far as this particular incident at Boise, Idaho, is concerned, I would like to quote the following paragraph from our letter of proposal dated the 18th of June, 1946:

"Whenever we submit proposals for engineering services, we anticipate that we will not be "the low bidder". We think that any municipality that selects consulting engineers on the basis of price alone will be quite certain not to obtain the best engineering services available."

That paragraph was inserted in our proposal so that Mayor Westerman Whillock would know that our proposal was being submitted with the understanding that we were not bidding for the work on the basis where the contract would be awarded on a price competition basis.

We have no fault to find with any of the other engineering firms who submitted proposals, or with the Mayor for any action taken by him and his city councilmen on this matter, but we do wish it to be known that we are not in the habit of bidding competitively on a price basis for engineering work.

ARTHUR W. CONSOER
Consoer, Townsend & Associates
Chicago, Illinois

Card Helps Public Relations

Sir: Recently we had the problem of building an oiled highway on a very heavily traveled road. We encountered a good deal of difficulty with tourists, who could not understand why work of this type had to be done at the peak of the tourist season, and no matter how many signs we put on the road it did not seem to alleviate the difficulty, so far as the traveling public was concerned.

We finally printed some cards, similar to the copy enclosed, and at both ends of the project we had uniformed Boy Scouts stationed to stop each car and hand one of these cards to the driver. This seemed to solve the problem and the traveling public seemed to understand, and from then on we had very little difficulty.

We thought others might be interested in these facts.

MORRIS E. ADELSTEIN,
President
Northwestern Engineering Company

To Those who are Traveling
This Highway . . .

This road is now under construction and we ask that you bear with us while using this highway.

At the moment there is a good deal of equipment on the job, the road is rather narrow and steep and the curves are sharp. When finished this road will be one of the finest.

Please be on the lookout for equipment on the highway, drive as carefully as possible, and we will see to it that you get through with the least possible delay consistent with safety.

When you come back over this road after it's completion we are sure that any inconvenience you may be put to at this time will be offset by the pleasure of riding on a splendid highway.

NORTHWESTERN ENGINEERING COMPANY

Rapid City, South Dakota

Drive Carefully and Enjoy the Hills!

Card used to advise tourists of road construction work ahead.

From Field and Office

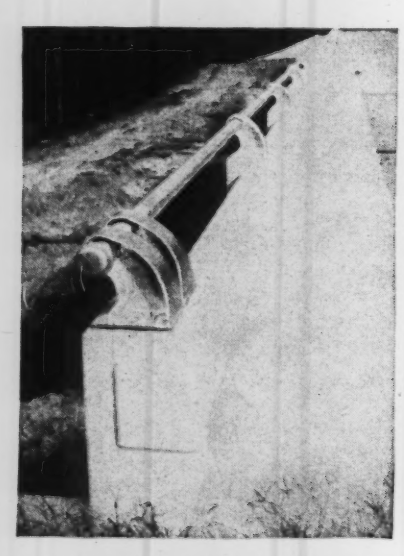
WORKING PROBLEMS AND TIME-SAVING METHODS FOR ENGINEERS AND CONTRACTORS

Handrail Is Designed For Beauty and Utility

The railing selected for a new highway bridge in South Carolina is illustrated by an accompanying photograph. Of pleasing appearance and economical construction, the railing is adequately proportioned to cause vehicles striking it to be deflected back toward the roadway.

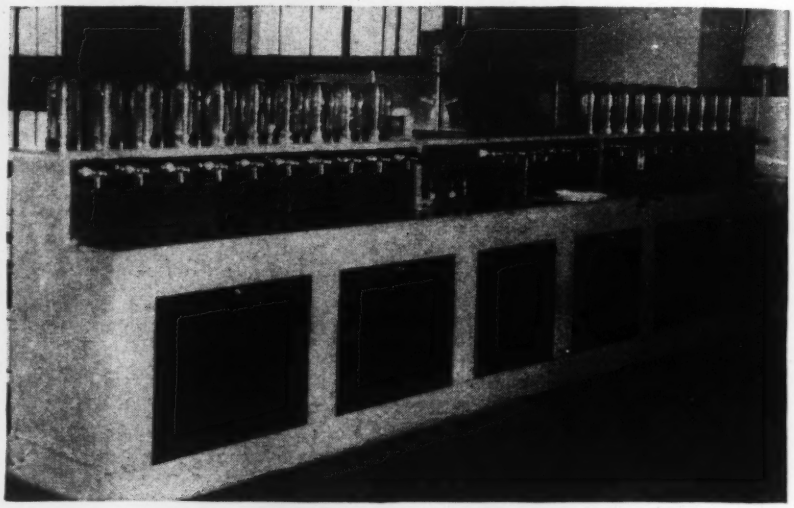
The concrete rail, well above the deck level, projects 1½ in. inside the vertical posts. The pipe rail is curved outward to provide more space above the 2½ ft. wide sidewalk yet be high enough for comfortable security. The pipe rail design also permits passing motorists a better view downward near the bridge.

The bridge, which spans the Pee Dee River, was designed under the supervision of W. J. Gooding, Jr., bridge engineer of the South Carolina State Highway Department, for which A. T. Clarkson was resident engineer. The C. Y. Thomason Co., Greenwood, S. C., built the railing for the bridge.



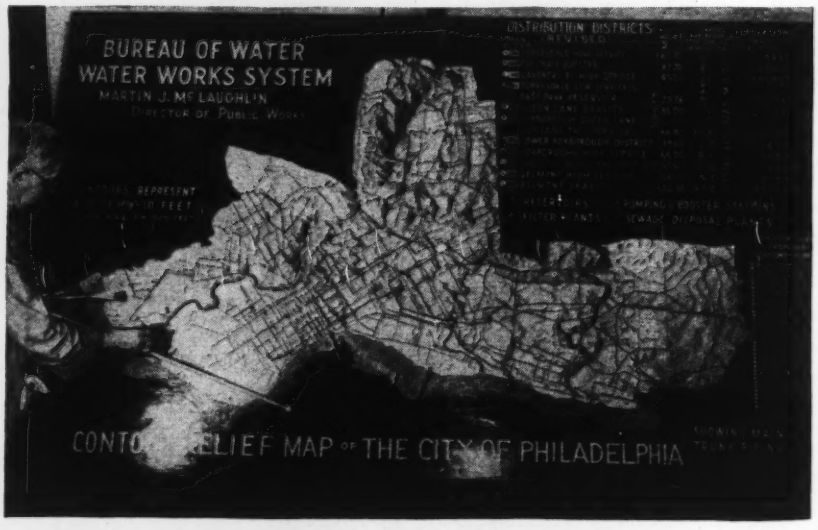
The railing for a new South Carolina bridge was designed to be sturdy, to result in little interference to the view of motorists, and at the same time appear to be adequate to pedestrians.

"SODA FOUNTAIN" CENTRALIZES FILTRATION PLANT SAMPLING



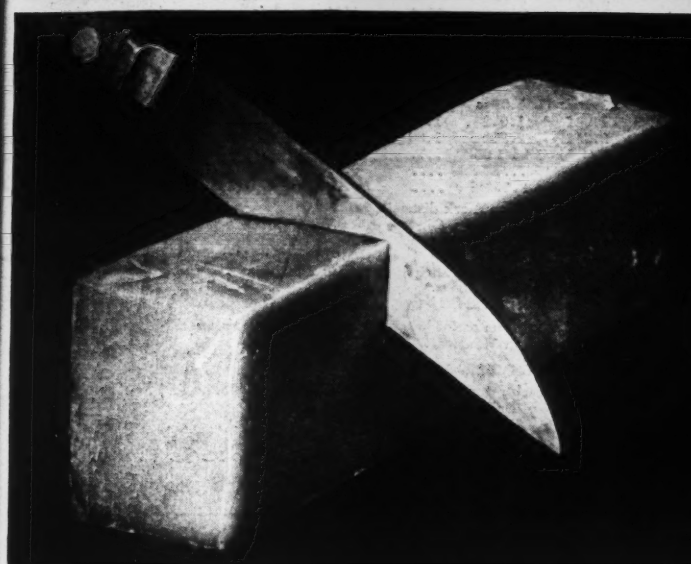
A converted drugstore soda fountain makes samples from any point in the Atlanta, Ga., water filtration plant easily available at a centralized location for inspection and analysis. Laboratory table drains have been arranged in the working-table surface on either side of the central sink. Explosion-proof glass light globes provide for visual inspection of flow from any of 26 sampling points before discharge from spiggots replacing dispensers. An aspirator for removing air from the globes, a centrifuge and chemical racks complete the installation.

RELIEF MODEL SHOWS WATER SYSTEM AT A GLANCE



Finishing touches are put on a relief model showing trunk piping of the Philadelphia, Pa., water system. With a companion model depicting distribution districts and consumption statistics the map aids in visualizing the inter-relationships of the system's component parts. The results of ten years effort, the models have paid for themselves by saving planners' time and bettering public relations.

FROM GREASE THAT FLOWS LIKE HONEY



TO GREASE YOU CUT LIKE SOAP

It is a fact that certain Shell *greases* for high-speed bearings are more fluid than heavy grades of lubricating *oil* . . . and that other Shell greases are solid "block" lubricants that are sliced up in bricks to be placed in the journals of heavy machinery.

It is also a fact that fluidity is just one of the factors a Shell Lubrication Engineer takes into account when he selects lubricants for your equipment. His stock in trade is a lubricant to meet your every need . . . his function is to select the right one for each job.

From his experience, the Shell Lubrication Engineer can help you when something's wrong and needs quick attention—and he can help prevent trouble by analyzing your equipment right now to see that you are getting the benefit of all that's new in lubrication.

Call him any time. He's a good man to know.

SHELL

SHELL OIL COMPANY, Incorporated

50 West 50th Street, New York 20, New York

100 Bush Street, San Francisco 6, California

MATERIALS AND LABOR PRICES

Market quotations on construction materials and wage rates reported monthly by ENR correspondents

Widespread price rises were felt this month. LUMBER again led the parade of increases. Southern Pine rose $18 per M ft. BM in Atlanta, $20 in Chicago, $10 in Kansas City, $22 in Philadelphia, and $39 in St. Louis. Douglas Fir rose $27 in Atlanta, $20 in Chicago, $11 in Denver, $10 in Kansas City, $14 in Los Angeles, $10 in Minneapolis, $25 in Philadelphia, and $15 in San Francisco. CAST IRON PIPE rose $4 in all cities. CEMENT increases ranging from $.05 to $.95 were effective in Atlanta, Baltimore, Dallas, Kansas City, Los Angeles, St. Louis, and San Francisco.

REINFORCING STEEL (new billet) rose $.10 per 100 lb. in Chicago, $.35 in Cincinnati, $.15 in Pittsburgh, $.50 in St. Louis, and $.035 in San Francisco. READY-MIXED CONCRETE rose $.48 in Dallas, $.03 in Los Angeles, $.35 in Minneapolis, and $.75 in St. Louis. The ENR 20-cities average of common labor WAGE RATES rose $.024 per hour, and of skilled labor, rose $.022 per hour. Increases in common labor rates occurred in Birmingham, Dallas, St. Louis, and Seattle, while skilled labor rose in Birmingham, Chicago, Dallas, New York, and Seattle.

CEMENT, AGGREGATE, READY-MIXED CONCRETE—F. O. B. CITY

	PORTLAND CEMENT (Per bbl C/L lots incl. 40c per bbl. for bags, cash dis. not deducted)			SAND AND GRAVEL (Per ton, carload lots)			CRUSHED STONE (Per ton, carload lots)		CRUSHED SLAG (Per ton, carload lots, f.o.b. plant)		CONCRETE BLOCK (8x8x16-in.; truckload del.; per block)		READY MIXED CONCRETE (1:2:4, over 5 c.y. del.)
	Cloth	Paper	Bulk	Gravel, 1½ in.	Gravel, ¾ in.	Sand	1½ in	¾ in.	1½ in.	¾ in.	Sand-grav.	Lt.wgt.Agg.	
Atlanta	$2.77	$2.52	$2.43	$1.79	$1.89	$1.65	$1.79	$1.89	$1.59	$1.69	$0.17	....	$9.00
Baltimore	2.75[a]	2.50[a]	2.25[a]	2.05‡	2.05‡	1.55‡	2.00‡	2.00‡	2.00‡	2.00‡	.145	$0.145[w]	8.00
Birmingham	3.65	2.80	....	2.06	2.06	1.63	2.50	2.50	1.00	1.20	.1425	.1425	6.90
Boston	3.70[bgg]	2.85[b]	2.60	1.50‡	1.50‡	1.40‡	1.25	1.35	....	....	.13	.155[w]	7.90[m]
Chicago	3.60	2.75	2.56	2.45‡[d]	2.45‡[d]	2.50‡[d]	2.45‡[d]	2.45‡[d]	1.75‡	1.75‡	.195	.195[x]	....
Cincinnati	2.59	2.34	2.14	1.20	1.20	1.10	1.80	1.80	....	....	.15	.18[w]	7.45
Cleveland	3.30	2.45	.....	.....	.....	.....	.....	.....	.....	.....	.19	.19	8.75
Dallas	3.31	2.46	2.21	1.80	1.80	1.60	1.89	1.99	....	....	.0875[p]	....	8.68
Denver	3.74	2.94	2.69	1.20	1.45	.90	1.65	1.75	....	....	....	.1625[w]	9.00
Detroit	3.28	2.43	2.23	2.65	2.65	2.35	2.25	2.25	2.00‡	2.00‡	.16	.17[w]	7.85
Kansas City	3.00	3.00	....	2.00	....	1.40	2.00	2.00	....	....	.16	.16[wy]	8.80[n]
Los Angeles	3.60[rjj]	2.90[r]	.....	1.55	1.55	1.40	1.40[f]	1.40[f]	1.40[f]	1.40[f]	.125[bb]	.14[bb]	8.75[m]
Minneapolis	4.10[dd‡jq]	3.85[dd‡]	....	1.25[h]	1.25[h]	.45[h]	1.25[h]	1.25[h]	....	....	.183[ff]	....	8.80[ykk]
Montreal	....	1.95[r]	1.80[r]	1.65‡[s]	1.65‡[s]	1.10[t]	.80[et]	.90[et]	....	....	.1391	.1515	7.75[ls]
New Orleans	2.41	2.16	1.92	1.67	1.65	1.21	....	....	.90	1.15	.23	....	9.25
New York	4.16‡[gg]	3.16‡	....	1.80[deu]	1.80[deu]	1.15[eee]	1.90[de]	1.90[ae]	....	....	.17[ii]	.18[wcci]	8.95[kq]
Philadelphia	2.75	2.50‡	2.30‡	1.55‡	1.65‡	1.20‡	1.90‡	1.95‡	1.25	1.25	.155	.155[w]	8.55
Pittsburgh	2.80	2.55	2.35	1.85‡	1.85‡	2.15‡	2.35‡	2.35‡	1.80	1.80	.21[z]	.21[z]	9.35
St. Louis	3.88[ohh]	3.00[o]	....	2.00‡[o]	2.00‡[o]	1.80/2.00‡[o]	1.25/1.95	1.25/1.95	....	....	.175	.22[yo]	9.45
San Francisco	3.37	2.47	2.07	1.46	1.46	1.56	1.56	....	....	....	....	.25[y]	8.55
Seattle	....	2.99[o]	....	2.35d‡	2.35d‡	2.35d‡	2.85‡[od]	2.85‡[od]	....	....	.17	....	8.25

‡ Delivered. *a* 10c. allowed for each returnable bag. *b* 10c. per bbl. off for cash. *c* F.o.b. quarry. *d* Per cu. yd. *e* Barge lots alongside docks. *f* Crushed granite. *g* F.o.b. Granite City, Ill. *h* F.o.b. plant. *i* Within three miles of Public Square. *j* 5% discount for cash. *k* Discount of 2 percent for cash in 10 days. *l* 2000 lb. concrete. *m* 50c. off for cash. *n* 25 c.y. or more. *o* 2% off for cash. *p* 5½ x 8 x 12 in. *q* 5 cu. yds. or more. *r* 10c. per bbl. off cash 20 days. *s* 8% sales tax included. *t* 8% sales tax not included. *u* In outlying New York districts, price is $1.89. *v* 20c. per bbl. discount; 80c. per bbl. for bags. *w* Cinder. *x* Waylite. *y* Haydite. *z* Celocrete. *aa* Pumice. *bb* 4 x 8 x 12 in. *cc* Also 8 x 18 in. *dd* Prices quoted are LCL. Carload lots not available. *ee* In outlying New York districts, price is $1.22. *ff* 8 x 8 x 18 in. *gg* $1.00 per bbl. refund for return of bags. *hh* $.20 per bbl. refund for return of bags. *ii* Yard price. *kk* 2500 lb. compression strength. *jj* 80¢ per bbl. refund for bags.

CASH DISCOUNTS CEMENT to Contractors: truck delivery, 2% for cash on 10th of month; on carload deliveries, no trucking, same as dealer cash discount. 10c. per bbl. for payment within 15 days of date of invoice. Subject discount 10c. per bbl. 20 days in Montreal.

CURRENT MAXIMUM PRICE BASES AT CEMENT MILL

Charge for bags not included. For cloth bags, add $1.05c. per bbl.; 25c. refund allowed for each returnable bag; for paper bags add 20c. per bbl., not refundable.

	Bagged	Bulk		Bagged	Bulk		Bagged	Bulk
Buffington, Ind.	$1.90	$1.85	Ironton, Ohio	$1.80*	$1.75*	Universal, Pa.	$1.85	$1.90
Hannibal, Mo.	1.90	1.85	Northampton, Pa.	1.75	1.70	Waco, Tex. (Plus 9c. tax in Tex.)	1.75	1.80
Independence, Kans.	1.90	1.85	Richard City, Tenn	2.05[a]	1.95	Montreal City (Discount 10c. per bbl. 20 days)	1.68	1.68
			Steelton, Minn.	2.00	1.95			

* Destination price base effective Sept. 17, 1945
a For cloth bags, add $1.00.

PAVING BRICK, BLOCK, ASPHALT, ROAD OILS—F. O. B. CITY

	PAVING BRICK AND BLOCK			PAVING ASPHALT (Per ton, less than 80 penetration)		ASPHALT BINDERS—FLUXES (Per gal., 80–300 penetration)		CUTBACK ASPHALT (Per ton)		ROAD OIL (Per gal.)	ASPHALT EMULSION (Quick-breaking) (Per gal)	
	Granite per M lots of 50,000 4x4x8 in.	Brick per M 3x4x8½ in. carload lots	Wood per sq. yd. 3½ in. 16-lb. treat	Tank car	Drums	Tank car	Drums	Tank car	Drums	Tank car	Tank car	Drums
Atlanta	$73.00	$35.00	$2.25	$14.00	.....	$0.074	.....	$0.0806[h]	.....	$0.0781	$0.0806	.....
Baltimore	150.00‡	52.70	85.00[m]	15.00[r]	21.00[r]	.06[r]	0.09[r]	13.00[r]	23.00[r]	.06[r]	.07[r]	.14[r]
Birmingham	.....	32.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Boston	85.00	59.00	3.75	16.00	25.00	.0675	.12	18.00	31.00	.0675	.0875	.15
Chicago	150.00‡	65.00/68.00[e]‡	2.85/4.00[d]	15.00/16.00	23.50	14.15/15.00[g]	22.65[g]	.0625/.0675[h]	.155/.16[h]	.05/.0575	.0925/.1025‡	.135/.155‡
Cincinnati	125.00	66.90	.....	19.40	.....	.10	.....	22.60	.....	.09	.10	.....
Cleveland	127.50	39.00	3.87	18.00	23.00	.0825	.105	18.00	23.00	.07	.10	.12
Dallas	.....	40.00	.....	15.36	22.70	.052	.10	17.95	28.00	.06	.0725	.135
Denver	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Detroit	.....	75.00[i]	.....	17.60[f]	26.56[f]	.0734	.128	.0718[h]	.119[h]	.067	.0974	.135
Kansas City	.....	45.00	.....	15.00[u]	20.60[u]	16.60[g]	.....	.07[h]	.0765[hu]	.....	.11	.15[u]
Los Angeles	.....	60.00	.....	9.00[b]	23.00[b]	9.50[bg]	24.00[bg]	9.50[bg]	.....	.03[b]	.08[b]	.16[b]
Minneapolis	.....	.....	2.39d‡	.....	.....	.....	.....	.....	.....	.....	.....	.....
Montreal	100.00	.....	.....	16.60[k]	24.25[k]	.1160[k]	.1485[k]	.115[hk]	.135[hk]	.08[k]	.135[k]	.188[k]
New Orleans	.....	.....	.....	13.00[a]	.....[s]	12.50[g]	.....[s]	6.50	.....[s]	.055	.08	.13
New York	.....	.....	2.75[n]	20.68	30.24[s]	.0834[t]	32.11[g]	.0857[h]	.1376[h]	.0807	.0822	.1328
Philadelphia	150.00	62.00	4.06	16.00	.....	15.00	.....	.0675[h]	.....	.....	14.00[gr]	.....
Pittsburgh	135.00	39.75	3.90	19.00	27.00	.095	.185	22.00	34.00	.075	.085	.15
St. Louis	.....	42.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
San Francisco	.....	47.75[e]	.....	11.75	21.00	11.75[g]	.....	13.75	.....	.....	.0525	.1125[i]
Seattle	.....	.....	.....	11.75[i]	22.75[i]	9.50	.....	11.75[i]	14.75	10.90[i]	.0525[i]	.0625

‡ Delivered *a* F.o.b. Baton Rouge. *b* F.o.b. Refinery. *c* 2½ x 8½ x 4 in. *d* 2-in. interior block, 6-lb. treatment. *e* 3½ x 4 x 8½. *f* Mexican. *g* Per ton. *h* Per gallon. *i* F.o.b. Martinez. *j* 3 x 3½ x 8½ in. *k* Tax included. *l* Quoted on request only. *m* Per thousand. *n* 2 in., treatment 6 lb. *r* February 1943 prices, none later available. *s* Drums not available. *t* Very scarce. Truck deliveries in small quantities.

IRON AND STEEL PRODUCTS—BASE MILL PRICES

	STRUCT. SHAPES-PLATE	REINF. BARS	RIVETS ¾-in. structural	WIRE NAILS	SHEET PILING	STEEL RAILS Per Net Ton			TRACK SUPPLIES			
						Standard	Light	Re-rolled	Angle Bars	Std Spikes c	Tie Plates c	Track Bolts
Birmingham	$2.35	$2.45	$5.25	$3.75	....	$50@0	$57.00	Not	$3.00	$3.65	$2.80	$6.50
Chicago	2.35	2.45	5.25	3.75	$2.65	50.00	57.00	avail-	3.00	3.65	2.80	6.50
Pittsburgh	2.35	2.45	5.25	3.75	2.65	50.00	57.00	able	3.00	3.65	2.80	6.50
Buffalo	2.35	2.45	....	....	2.65	.....	.....	.....	....	....	2.80	....
Cleveland	....	2.45	5.25	3.75	....	.....	.....	.....	....	....	....	....
Youngstown	....	2.45	....	....	....	.....	.....	.....	....	3.65	....	....
Detroit	....	2.585‡	....	....	....	.....	.....	.....	....	....	....	....
Gulf ports	2.735a	2.835a	....	....	2.85a	.....	.....	.....	....	....	....	....
Pacific ports	3.035a	2.885a	....	4.25a	3.235a	.....	.....	.....	....	3.90	2.80	....

‡ Delivered. *a* F.o.b. cars dock. *b* Rail steel same as billet prices. *c* Other basing points include Portsmouth, O., Weirton, W. Va., St. Louis, Kansas City, Minnequa, Colo., and Pacific coast ports, on tie plates alone. Steelton, Pa., on spikes alone, Lebanon, Pa., Richmond, Va. *d* Add switching charge $18 per cl.

IRON AND STEEL PRODUCTS—F. O. B. WAREHOUSE, PER 100 LBS., BASE PRICE

	STRUCTURAL SHAPES	REINFORCING BARS*g* Per 100 lb., ¾ in., base price			EXPANDED METAL LATH Per 100 sq. yd., carload lots		WELDED FABRIC REINFORCING Per 100 sq. ft., carload lots			SHEET PILING
	Per 100 lb. base price	15 tons or over *b* New billet	Rail steel	Add $/cwt. for Switch Del	Std diamond mesh, 3.4 lb	Std ribbed 3.4 lb	4x16 in., No 5 & 10 wires	4x12 in., No 8 & 12 wires	6x6 in. No. 6 & 6 wires Per 100 s. f.	Per 100 lb. base price
Atlanta	$4.05‡	$4.12‡	$4.12‡	$.025 $.10	$23.16	$25.30	$1.93	$1.45	$2.05	$3.35
Baltimore	3.909	3.344	....	.... .10	24.50	26.50	1.81	1.37	1.93	3.25
Birmingham	2.35	2.35	2.35	.025 .10	36.00*p*	39.00*p*	1.91	1.44	2.03	....
Boston	4.162‡	4.194‡	2.97*e*	$20 C.L. .10	18.50	20.50	1.87	1.41	1.98	3.02
Chicago	2.35*a*	2.45*a*	2.45*a*	.03 .05	22.50‡	24.50	1.78	1.35	1.89	2.65
Cincinnati	3.983	3.25*cd*	3.25*cd*	.... .10	....*n*	....*n*	1.80	1.36	1.89	....
Cleveland	....	3.65	3.55	.025 .10	24.50	26.50	1.77	1.35	1.88	....
Dallas	5.25	4.17	4.17	....	31.00	35.00	2.04	1.52	2.17	....
Denver	4.89	4.77*o*	....	....	37.00	41.00	2.08	1.55	2.21	....
Detroit	3.952‡	3.14‡	3.14‡	.... .10	38.00‡	41.00‡	1.79	1.36	1.90	2.95
Kansas City	4.44	2.75*cd*	2.75*cd*	.0 .05	29.50	31.50	1.89	1.43	2.01	3.0826
Los Angeles	5.20*f*	3.025	2.875	.03 .05	23.00	27.50	2.04	1.52	2.17	5.20
Minneapolis	4.142‡	2.99	2.99	.0 .10	25.00	27.00	1.91	1.44	2.03	3.06*d*
Montreal	4.55*i*	3.50*i*	3.35*i*	....	31.00*hi*	46.00*hi*	2.87	3.54*i*	2.96*im*	....
New Orleans	4.408‡	3.84	4.108	.05 .10	22.00	24.00	1.93	1.45	2.05	3.125
New York	4.008	2.96*c*	2.96*c*	.... .15	17.50	19.50	1.83	1.39	1.93	2.74
Philadelphia	3.937	3.899	....	....	20.50‡	22.50‡	1.82	1.38	1.93	2.97
Pittsburgh	2.35*a*	2.50*a*	2.50*a*	.025 .10	23.00	26.50	1.70	1.30	1.81	2.65
St. Louis	3.40	3.46	3.46	.0 .05	34.00	36.00	1.80	1.37	1.92	....
San Francisco	4.60	3.06	2.875	.025 .10	28.00	31.50	2.04	1.52	2.17	3.335
Seattle	3.00*e*	3.00*e*	....	....	43.50	44.00	2.04	1.52	2.17	3.20*e*

‡ Delivered. *a* Mill prices. *b* 5–15 tons, add 15c. 1–5 tons, add 25c. Less than 1 ton, add 50c. *c* 20 tons or over Base. *d* Mill price plus freight. *e* F.o.b. dock. *f* Includes delivery in free delivery zone. *g* High scrap steel prices cut former 15c. differences between new billet and rail steel in many mills. *h* List price. *i* Plus Dominion and Province sales tax. *m* Per sq. yd. *n* Practically no carloads are available. Retail price delivered is $27.00 for std. diamond mesh and $29.00 for std. ribbed. *o* 20 tons and over. *p* Deliveries of 5000 sq. yd. or less.

PLUMBING, HEATING, WATER, SEWER AND DRAIN PIPE

	C. I. PIPE	VITRIFIED SEWER PIPE				CLAY DRAIN TILE		CONCRETE SEWER PIPE		WROUGHT STEEL PIPE (Full standard weight, f.o.b. destination *s*)			
	Per net ton f.o.b. 6 in. to 24 in. *a*	Per foot, std. 8 in. s.s.	Delivered std. 12 in. s.s.	ASTM 24 in.	C13–35 36 in.	Per 1,000 ft., carload lots, f.o.b. 6 in	8 in.	Per ft., delivered; ASTM 12 in.	C 14–35 24 in.	1 to 3 in., Butt Weld Black %	Galv. %	3½ to 6 in., Lap Weld Black %	Galv. %
Atlanta	$69.66	$0.43	$0.67	$3.39	....	$114.00	$140.00	$0.45	$2.00	58.5	47.5	56.0	44.5
Baltimore	74.20	.35	.60	2.70	$7.25	160.00	200.00	.85	2.25	62.1	51.1	59.6	48.1
Birmingham	65.00	.375	.675	3.06	....	210.00	350.00	.57/1.00	1.85/2.50	58.5	47.5	56.0	44.5
Boston	76.80	.392*m*	.756*m*	3.15*m*	7.995*m*	170.00‡*m*	265.00‡*m*	.53	2.04	66.0	49.6	58.1	46.6
Chicago	74.33	.49	.945	3.60	....	110.00‡	150.00‡	.65	2.25	64.0*t*	53.0*t*	60.5*t*	49.0*t*
Cincinnati	73.27	.327	.6345	3.735	10.04	98.70	151.60	.54	2.00	62.6	51.6	60.1	48.6
Cleveland	74.75	.32*m*	.621	2.565	5.535	154.00	239.00	.58	2.25	64.71	53.71	62.21	50.71
Dallas	76.43	.375	.675	2.70	6.20	109.00	131.00	.45	1.45	56.5	45.5	53.9	42.4
Denver	81.56	.36	.648	2.70	....	154.00‡	295.00‡	.50	2.00	54.4	43.4	51.6	40.1
Detroit	74.75	.455	8.775	3.375	8.50*l*	170.00‡*m*	263.00‡*m*	.40	1.45	63.1	52.1	60.6	49.1
Kansas City	75.73	.345	.625	2.47	6.85	173.00	312.00	.45	1.60	60.1	49.1	57.2	45.7
Los Angeles	88.40	.414†	.745†	2.988	7.47	157.00	260.00	1.25	2.50	....	....	....	....
Minneapolis	77.83	.47†*o*	.90†*o*	3.65†*o*	....	.....	.....	.90	2.40	60.2	49.2	57.3	45.8
Montreal	78.20	.85*k*	1.50*k*	5.25*l*	8.50*el*	45.00*j*	64.00*j*	.811*j*	2.513*j*	....	....	....	....
New Orleans	71.78	.31	.558	3.558	....	112.00	.....	....	....	58.0	47.0	55.5	44.0
New York	73.60	.52	.96	3.82	9.18	.....	.....	.60	1.40	61.5	50.5	59.0	47.5
Philadelphia	72.10	.40	.7735	3.20	8.50	200.00	275.00	.80	2.15	61.9	50.9	59.4	47.9
Pittsburgh	75.18	.322†*m*	.631†*m*	2.70†*m*	6.625*m*	124.20	193.80	1.05	2.50*g*	65.25*t*	54.25*t*	62.75*t*	51.25*t*
St. Louis	72.84	.351*n*	.632*n*	2.527*n*	5.60*n*	105.80	212.00	1.20*h*	2.55*i*	61.9	50.9	58.6	4.71
San Francisco	88.40	.4375*d*	.7875*d*	3.15	7.875	124.50	207.50	.65	2.70	....	....	....	....
Seattle	90.20	.4375*b*	.7875*b*	3.15	....	.....	.....	.56*f*	1.60*f*	....	....	....	....

‡ Delivered. † F.o.b. *a* B. & S. class B and heavier, C/L lots, Burlington, N. J. (base) $66.00. Based on existing freight rates; subject to rate change. Gas pipe and class A, $5 per ton additional. 4 in., $5 per ton additional, 30 in. and larger, usually $1 per ton less. *b* Double strength. *d* List. *e* 30 in. *f* Less 5% for cash. *g* Culvert pipe. *h* Reinforced; spec. C–76–37. *i* Reinforce, spec. C–75–41. *j* Centri-spun. *k* Less 50%. *l* Less 53%. *m* Truck delivery. *n* Less 3% for cash. *o* Since carload lots are not available at this time, listed price is based on LCL (no minimum).

s Discounts from standard list consumers carload prices. Base price approx. $200 per net ton. List prices per ft.: ¼ in., 8¼c.; ⅜ in., 11¼c.; 1 in., 17c.; 2 in., 37c.; 2½ in., 58½c.; 3 in., 76½c.; 4 in., $1.09; 6 in., $1.92; 3 percent tax on transportation costs not included. *t* Within switching limits. WROUGHT IRON PIPE: List prices per ft. same as wrought steel pipe. Discount for Pittsburgh base. Buttweld — 1 in. and 1¼ in. black, 34, galv., 16; 1½ in. black, 38, galv., 18½; 2 in. black, 37½, galv., 18. Lapweld — 2½ in. to 3½ in. black, 31½, galv., 14½; 4½ in. to 8 in. black, 32½, galv., 17. Freight rates to destination to be added to name delivered price.

LUMBER, TIMBER, PLYWOOD—PER M FT., B.M., CARLOAD LOTS F. O. B.

	SHORT LEAF YELLOW PINE AND DOUGLAS FIR									LONG LEAF Y. P	PLYWOOD	
	All S. L. Y. P. is No. 2 common or better and for No. 1 N C Box. (Prices in Bold Face)									Merchantable grade up to 20 ft.	Rail freight increment (See note for base price)	
	All Fir planks No. 2 common, Fir timber is No. 1 common. Lengths up to 20 ft (Prices in italics)											
	1x6 s¹s	1x8 s¹s	2x4 s s	2x6 s¹s	2x8 s¹s	2x10 s¹s	3x12 R¹	6x12 R¹	12x12 R¹	2x12 R¹	12x12 R¹	¼"
Atlanta	$75.00	$75.00	$65.00	$65.00	$65.00	$65.00	.....	.....	.....	$86.00	$86.00	$17.72
	90.00	*90.00*	*88.50*	*88.50*	*87.50*	*87.50*	*$81.00*	*$80.50*	*$79.50*	.....	.....	.....
Baltimore	74.00	75.00	71.00	70.00	70.00	77.00	90.00	.....	.....	185.00	180.00	18.45
	80.00	*82.00*	*80.00*	*74.00*	*79.00*	*80.00*	*95.00*	*87.00*	*85.00*	.....	.....	.....
Birmingham	87.50	87.50	87.00	86.00	87.00	90.00	110.00	.....	.....	110.00	112.50	17.245
[1]	*92.50*	*92.50*	*92.00*	*91.00*	*92.00*	*95.00*	*114.00*	*97.00*	*98.00*	.....	.....	.....
Boston	70.00[3]	72.00[3]	66.50[3]	62.50[3]	70.50[3]	74.50[3]	70.25[3]	.....	.....	.....	.....	18.195
	64.75	*64.75*	*62.75*	*63.25*	*62.75*	*62.75*	*60.50*	*59.50*	*59.50*	*59.50*	.....	.....
Chicago ‡	85.00	86.00	82.00	82.00	82.00	89.00	95.00	.....	.....	117.00	117.00	14.555
	88.50	*88.50*	*86.50*	*86.50*	*85.50*	*86.50*	*87.50*	*83.00*	*84.00*	.....	.....	.....
Cincinnati	51.00	52.50	46.00	46.00	48.00	56.00	70.50	.....	.....	68.50	68.50	17.245
Cleveland *k*	125.00	125.00	130.00	130.00	130.00	134.00	148.00	.....	.....	140.00	170.00	17.615
k	*120.00*	*120.00*	*130.00*	*130.00*	*130.00*	*134.00*	*140.00*	*140.00*	*160.00*	.....	.....	.....
Dallas	59.50	57.75	56.75	57.75[j]	59.00	61.50	64.50	.....	.....	94.75	91.00	14.555
Denver	*89.00*	*89.00*	*85.00*	*85.00*	*88.00*	*84.00*	.....	.....	.....	.....	.....	10.285
Detroit	90.00	90.00	87.00	87.00	87.00	93.00	100.00	.....	.....	95.00	110.00	17.245
	98.00	*98.00*	*96.00*	*97.00*	*97.00*	*100.00*	*105.00*	*105.00*	*110.00*	.....	.....	.....
Kansas City *a*	86.00	86.00	84.00	82.75	83.25	86.00	105.00	.....	.....	105.00	110.00	12.605
	88.00	*88.00*	*87.50*	*87.50*	*85.50*	*87.00*	*85.00*	*105.00*	*105.00*	.....	.....	.....
Los Angeles *a*	*87.00*	*87.00*	*88.00*	*89.00*	*87.00*	*87.00*	*100.00*	*100.00*	*89.00*	.....	.....	9.81*gh*
Minneapolis ‡*b*	94.00[4]	92.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	13.765
‡	*95.00*	*95.00*	*89.75*	*90.00*	*88.75*	*90.25*	*84.50*	*86.25/94.25*	*86.75/94.75*	.....	.....	.....
Montreal *e*[7]	69.00	70.00	64.00	68.00	70.00	75.00	.20¢	.....	.....	.20¢	.20¢	.....
	97.00	*97.00*	*97.00*	*97.00*	*97.00*	*97.00*	*87.00*	*87.00*	*87.00*	.....	.....	.....
New Orleans	42.00	42.00	39.00	38.50	38.50	42.00	46.00	.....	.....	54.50	69.00	14.555
	30.50	*30.50*	*30.00*	*30.00*	*29.00*	*29.00*	*28.50*	*29.50*	*29.50*	.....	.....	.....
New York ‡	Range from $105.00 to $110.00						$120.00	.....	.....	.....	.....	18.195
‡	Range from $105 to $115						*Range from $110 to $130*			.....	.....	.....
Philadelphia	Range from $105 to $110						.....	.....	.....	150.00	150.00	18.195
	Range from $110 to $120						*120.00*	*120.00*	.....	.....	.....	.....
Pittsburgh	59.40	61.80	71.35	63.60	69.45	73.10	84.85	.....	.....	130.60	141.00	17.88
	77.60	*76.70*	*74.70*	*73.90*	*73.80*	*74.35*	*91.35*	*96.85*	*96.85*	.....	.....	.....
St. Louis *j*	112.00	112.00	110.00	108.00	108.00	115.00	115.00	.....	.....	.....	.....	14.555
San Francisco *d*	*91.00*	*91.00*	*87.25*	*87.25*	*86.25*	*86.25*	*81.00*	*72.50*	*72.50*	.....	.....	7.33*g*
Seattle	*50.50a*	*50.50a*	*50.50a*	*50.50a*	*50.50a*	*50.50a*	*45.00a*	*45.00a*	*45.00a*	.....	.....	8.83*g*

Bold Face type. Southern Pine. *Italics, Douglas Fir.* [1] Long leaf [2] Roofers' N. C. Pine. [3] Spruce. [4] Native. [5] Western Pine, No. 3 Common. [7] Spruce. [8] Norway Pine. ‡ Delivered. *a* Yard prices. *c* 5M ft. or less. *d* Sales through wholesale distribution yard (F.o.b. purchaser's truck or carrier. San Francisco paid). *e*[7] *e* Plus sales tax. *f* Up to 18 ft. *g* Lower rate by water shipment. *h* 50,000 lb. minimum. *j* FBM, scarce, no stable quotation, no ceiling. *j* Delivered in 500 ft. lots. *k* These are retail yard prices. Lumber is no longer available on the base previously quoted.

Note: Special concrete form grade Fir Plywood, 4' by 8' panels, 5-ply, sanded 2 sides, water resistant glue, carload lots, delivered per 1,000 sq. ft. surface. Seattle base price on ½", $95.15; on ¼", $104.85; price includes oiling and sealing charges. For other centers add rail freight increment from table or proper size. For resin dipped treatment, add $10.50 per M.

GLASS, EXPLOSIVES, CHEMICALS

	WINDOW GLASS Discounts from jobbers list Aug. 15, 1938 Single or Double Thickness		EXPLOSIVES Per lb. 40% Ammonia Gelatin in 50 lb. cases delivered in 200 lb. lots*
	A quality	B quality	
Atlanta	76%	76%	$0.18
Baltimore	78%	79%	.18
Birmingham	76%	76%	.135
Boston	77%	78%	.18
Chicago	725%	725%	.18
Cincinnati	77–10%	77–10%	.18
Cleveland	72–10–10%	77%	.22
Dallas	76%	76%	.1925
Denver	72%	72%	.185
Detroit	77%	77%	.18
Kansas City	72.510%	72.510%	.18
Los Angeles	86%*d*	88%*d*	.1875
Minneapolis	73%	73%	.175
Montreal	40–5%*ab*	47%*ac*	.1975
New Orleans	70%	75%	.19
New York	76%*e*	77%*e*	.25*f*
Philadelphia	74%	75%	.18
Pittsburgh	77%	77%	.1525
St. Louis	77–10%	77–10%	.185
San Francisco	66%	73%	.185
Seattle	75%	75%	.1875

Price of 60% Ammonia Gelatin is $0.01 per lb. higher than 40%

a Discount from list Sept. 1939: sales tax included, but 6% tax exemption not allowed for. *b* Single thickness. *c* Double thickness. *d* Discount from jobbers' list Sept. 15, 1928. *e* Discount from jobbers list Jan. 16, 1946. *f* In borough of Kings, Queens and Richmond, and in Manhattan south of Canal St., add delivery charge of $6.00 per trip.

* Urban prices influenced by service charges or local storage and delivery regulations do not consistently reflect quantity prices in less congested areas.

40% Ammonia Gelatin price ranges in other than urban areas, per lb.
(except Seismograph Grades)

	C/L 20,000 lb. net	Tons	200 lb. lots
E. of the Miss., except Fla. and Me.	$0.135	$0.16	$0.18
W. of Miss. to Rocky Mtn. States, Fla. and Maine.	.14 –.1475	.165 –.1775	.185 –.1975
Rocky Mtn. States	.14 –.1525	.165 –.1825	.185 –.2025
Pacific N. W. States	.1375–.15	.1675–.18	.1875–.20
Pacific S. W. States	.1350–.1425	.165 –.1725	.185 –.1925

PILES, TIES F.O.B.

PILES

Prices per linear foot, fir and pine, bark on, f.o.b. cars New York. Fir based on Wash. and Ore. points to New York shipping area; pine based on freight from Norfolk.

Dimensions	Points	Length	By Rail Pine *	By Rail Fir
12 in. at butt	6 in.	30 to 50 ft.	$0.34	....
12-in.— 2 ft. from butt	6-in.	50 to 59-ft.	.35	....
12-in.— 2 ft. from butt	6-in.	60 to 69-ft.	.36	....
12-in.— 2 ft. from butt	6-in.	90 to 100-ft.	....	.56
13-in.— 3-ft. from butt	5-in.	91 to 100-ft.	....	.58
14-in.— 2-ft. from butt	6-in.	50 to 69-ft.	.41	.65
14-in.— 2-ft. from butt	6-in.	70 to 79-ft.	.43	.59
14-in.— 2-ft. from butt	5-in.	80 to 85-ft.	.54	....
14-in.— 2-ft. from butt	5-in.	85 to 89-ft.	.57	....
14-in.— 2-ft. from butt	5-in.	90 to 100-ft.	....	.64

* Pine piling over 80-ft. available only in limited quantities.

RAILWAY TIES

Prices f.o.b. per tie for carload lots:		6"x8"x8' Untr.	6"x8"x8' Tr.	7"x9"x8'6" Untr.	7"x9"x8'6" Tr.
Boston	Oak	$1.50	.....	$2.00	.....
	Pine	2.00	$3.00*a*	2.50	$3.00*a*
New York	S. L. Sap Pine	1.65	2.85	2.00	3.30
	Mixed Oak	1.80	3.05	2.50	3.60
Birmingham	Hardwood	1.00	1.60*a*	....	2.25*a*
Chicago	Red Oak	.....	2.45/2.65*a*	.....	3.35/3.60
Los Angeles	Douglas Fir	2.10	3.35*a*	3.00	4.80*a*
Philadelphia	Red Oak	.....	2.10*gg*	.....	3.25*ag*
St. Louis	White Oak	1.80	.....	2.50	.....
	Red Oak	....	2.40*a*	....	3.40*a*
	Sap Pine or Cypress	2.20	.....	2.06	.....
San Francisco	Douglas Fir	1.25*bd*	.....	....	3.00*caf*
Montreal	Birch or Maple	.....	1.65	1.04	.....

Tr.— Treated; Untr.— Untreated. *a* Creosoted. *b* 6"x8"x8'6" *c* Empty cell. *d* Zinc. *e* Green. *f* F.o.b. cars. † Out of market. *g* January 1943 price, none later available.

CHEMICALS

Water, sewage treatment, road work, f.o.b. carlots, New York

Bleaching powder in drums f.o.b. works, per 100-lb	$2.50– 3.10
Chlorine cylinders, liquid, per lb. delivered	.0525
Calcium chloride, 77–80%, flaked, 100-lb. paper bag, del'd ton	18.50–35.00
Silicate of soda, 52 deg., in drums, f.o.b. works, per 100 lb	1.40
Soda ash, 58%, in paper bags, per 100 lb. dense	1.15
Sulphate of aluminum, commercial, in 100-lb. bags	1.15–1.20
Sulphate of copper, in bbl., per 100-lb	5.00

STRUCTURAL CLAY BUILDING TILE, BRICK AND LIME—DELIVERED

	STRUCTURAL CLAY TILE PARTITION — SCORED Per M. lots of 2,000 pieces or over, 3x12x12 in.	4x12x12 in.	8x12x12 in.	STRUCTURAL CLAY TILE — LOAD BEARING — SCORED Per M. lots of 2,000 pieces or over 8x12x12 in.	10x12x12 in.	12x12x12 in.	BRICK Per M. in quantity. Common backing	Straight hard	LIME Per ton, Hydrated finishing	In paper, Common hydrated	Carload lot, Pulverized, or lump
Atlanta	$112.50	$132.60	$234.60	$244.80	$273.40	$306.00	$24.00	$24.00	$19.00	$17.50	$17.50
Baltimore	90.00	95.00	175.00	200.00	260.00	300.00	23.75*k*	29.75*k*	20.00	15.00	2.50*m*
Birmingham	97.50	104.00	195.00*c*	231.00	.....	.....	19.00	21.50	20.11	17.05	18.05
Boston	105.00†	112.00†	240.10†	252.09†	.....	.....	20.00*i*	20.00*i*	21.00†	.....	16.00
Chicago	92.10	98.40	185.20	.....*x*	.....*x*	.....*x*	18.50	19.50	18.00	16.00	.....
Cincinnati	75.39	80.39	150.90	170.91	242.35	277.25	33.00	33.00	16.90	14.40	.....
Cleveland	98.10	104.55	.....*x*	196.00	.....	.....	28.00	28.00	17.05	14.55	19.55
Dallas	.....	83.00	.....	.....	.....	.....	32.50	30.50	28.00	22.00	15.00
Denver	105.25	119.00	198.25	230.00	263.50	315.25	26.50	28.00	30.00*j*	28.00*j*	34.00
Detroit	92.70	96.70	174.50	198.80	257.20	294.30	24.00*f*	25.00*f*	22.00	20.00	20.00
Kansas City	.....	.....	.....	.....	.....	.....	17.50	18.50	34.00	30.00	30.00
Los Angeles	*r*	*r*	*r*	*r*	*r*	*r*	16.50	18.50	21.80	18.80	22.80
Minneapolis	.....	.....	.....	.....	.....	.....	18.50*e*	.....*g*	29.20*bb*	22.00*bb*	29.20*bb*
Montreal	92.50*a*	98.50*a*	196.25*a*	151.50*a*	.....	294.40*a*	.....	.....	12.50*u*	14.00*u*	8.00*u*
New Orleans	104.50	109.55	207.25	222.25	326.90	385.65	17.75	.....	18.30	12.08	14.10
New York	103.90	110.80	152.35	166.70*hn*	.....*x*	.....*x*	25.50	.....	28.60	22.60	.....
Philadelphia	112.10	119.60	224.20	269.10	321.20	405.10	24.75	27.75	22.00	18.00	17.00
Pittsburgh	98.50	105.80	181.85	217.30	265.85	303.10	24.00	26.00*y*	19.40*cc*	16.90*cc*	2.85*m*
St. Louis	.....	.....	.....	.....	.....	.....	26.00*s*	25.00*s*	24.00*s*	20.00*s*	.75*s*
San Francisco	116.00	130.50	174.00	130.50*t*	.....	.....	25.00	.....	21.90	21.90	2.19*m*
Seattle	129.25	141.50	.....*x*	141.50*cc*	.....	.....	23.00*k*	28.00*k*	27.95*s*	27.95*s*	3.28*m*

* F.o.b. *a* Smooth. *b* Carload lots delivered to job. *c* 6 x 12 x 12 in.-3 cell *f* Includes $3.50 per M. for delivery. *g* No quotation. *h* F.o.b Perth Amboy, N. J. *i* F.o.b. Warehouse only. *j* OPA Price. *k* $1.00 discount. *m* Per bbl., 180 lb. *n* 7⅝ x 7⅝ x 12. Speed tile. *o* Per bbl., 200 lb. *r* Not used because of earthquake danger. *s* 2% discount for cash. *t* 5½ x 8 x 11½. *u* 8% sales tax included. *v* sand lime. *x* Not available. *y* Stacked. *z* Pebble lime, price per 80 lb. sack. *bb* LCL, delivered. *cc* Truck delivery.

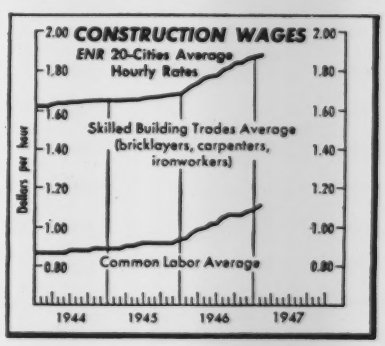
PAINT, ROOFING—F.O.B. CARLOAD LOTS

	RED LEAD Per 100 lb. in 600-lb. (Approx.) bbl. Dry *a*	WHITE LEAD Per 100 lb. in 100 lb. cases In oil *w*	READY-MIXED PAINT Per gal., drums Graphite *b*	Aluminum *c*	Ferric Oxide *d*	ROOFING SUPPLIES Carload lots f.o.b. factory Rolls, slate surfaced, 85–90 lb. per sq.	Asphalt felt, per 100 lb.	Tar felt, per 100 lb.	Asphalt coating per gal.	Tar pitch 360 lb. bbl. per ton
Atlanta	$15.50	$23.625	$1.75	$2.70	$1.65	$2.06	$2.06	$2.06	$1.00	$36.00
Baltimore	15.25	23.25	2.00	3.00	2.50	2.35	2.90	2.90	.40	29.00
Birmingham	15.50	23.625	3.36	4.70	....	2.50	2.50	2.50	.33	30.50
Boston	15.25	23.25	1.75	2.50	2.31	2.00‡*h*	3.30‡*u*	3.30‡*u*	.25‡	21.00‡
Chicago	15.25	23.25	....	....	....	1.75*hf*	1.99*hf*	1.99*hf*	.33*f*	23.00*f*
Cincinnati	15.25	23.25	1.70	2.90	1.60	2.20	2.10*h*	2.10*h*	.33	25.00
Cleveland	15.25	23.25	....	....	....	2.10	2.15*h*	2.15*h*	.237	26.00
Dallas	15.25	24.00	....	4.05	....	2.25*h*	2.50*h*	2.75*h*	.70	45.00
Denver	15.25	23.75	2.75	4.35	2.50	2.87	2.40*h*	2.40*h*	.35	28.50
Detroit	15.25	23.25	1.75	3.00	1.60	2.25	2.25	2.25	.50	23.00
Kansas City	15.25	23.375	3.30*g*	3.55*g*	3.16*g*	3.00	3.25	3.25	.67	.....
Los Angeles	15.50	23.75	2.80	4.00	3.50	2.60	1.90	....	.60	.....
Minneapolis	15.25	23.88	....	....	....	1.995*i*	2.0425*hi*	2.0425*hi*	.32	26.00
Montreal	.....	.....	2.90*p*	4.20*p*	3.62*p*	2.85	2.58*t*	2.07*t*	.68	1.85*k*
New York	15.25	23.25	2.91	....	2.70	1.995	2.0465*o*	2.0465*o*	.30	26.00
Philadelphia	15.25	23.25	1.60/1.80	2.20	1.55	2.30	2.81	2.81	.32	23.00
Pittsburgh	15.25	23.25	1.95	2.40	1.75	2.32	2.37*h*	2.37*h*	.37	28.00
St. Louis	15.25	23.25	2.28*s*	2.89*s*	1.96*s*	....	....	....	....	.....
San Francisco	15.50	23.50	1.80	2.75*n*	1.35	1.7613	4.72	2.472	.3399	21.115
Seattle	15.50	23.75	1.95	3.09	....	2.22	2.23*h*	....	.36	31.93*j*

‡ Delivered. Note: Red lead in oil 50c higher than white lead in oil. *a* Red lead prices change frequently due to pig lead price changes. *b* U. S. War Dept. Spec. 3–49A. *c* ASTM Spec. D266–31. *d* 80% minimum ferric oxide. *f* Distributors' price to contractors. *g* 55 gal. can. *h* Per roll, 65 lb. *i* Minneapolis and vicinity. *j* Asphalt pitch. *k* per cwt *n* May, 1941 price. *o* 60-lb. roll. *p* Plus 8% sales tax. *s* December, 1942 price. *t* Federal tax included. *u* 90-lb. roll. *v* Truck delivery. *w* Price to large paint contractors is $1.25 less.

SKILLED AND COMMON WAGE RATES—PER HOUR

	Bricklayers	Carpenters	Struct. Iron Workers	Hoisting Engineers	Plasterers	Common Labor Building	Common Labor Heavy Const.
Atlanta	$2.00	$1.50	$1.625	$1.50	$1.625	$0.75	$0.80
Baltimore	1.90	1.775	2.00	1.625/2.00	1.725	.95	.95
Birmingham	1.9375	1.50	1.75	1.50/1.75	1.875	.75	.85
Boston	1.725	1.75	1.85	1.65	1.667	1.25	1.25
Chicago	2.00	1.95	2.00	1.95	2.00	1.30	1.30
Cincinnati	1.875	1.65	1.775	1.875/2.125	1.875	.95	.95
Cleveland	2.125	2.00	2.125	2.125	2.125	1.375	1.375
Dallas	2.00	1.625	1.75	1.75	1.875	.90	.90/1.25
Denver	1.98*b*	1.70	1.70*b*	1.70*b*	1.90	1.10	1.10
Detroit	2.00	1.825	2.00	1.85/2.00	2.00	1.275	1.275
Kansas City	2.00	1.75	1.875	1.875	2.00	1.175	.90
Los Angeles	2.00	1.75	2.00	1.75	2.05	1.25	1.25
Minneapolis	1.825	1.65	1.75	1.70	1.90	1.15	1.15
New Orleans	1.625	1.375	1.625	1.55	1.625	.70	.80
New York	2.50*b*	2.10*b*	2.25	2.25*b*	2.50*b*	1.25	1.25
Philadelphia	2.00/2.25	1.775	1.90/2.00	2.25	2.00/2.25	1.025	1.025
Pittsburgh	2.15	2.00	2.00	2.05	2.00	1.15	1.15
St. Louis	2.00	1.95	2.00	2.20	2.25	1.20	1.20
San Francisco	2.05	1.75	2.00	1.85	2.00	1.25	.125
Seattle	2.105	1.805	1.93	1.95	2.105	1.405	1.30
Montreal*	1.17	1.06	1.11	1.00	1.17	.73	.73



b 7 hr. day. * Cost of living bonus now included in basic wage.

ENR Skilled Average: (Bricklayers, Carpenters, Ironworkers) $1.885.

ENR Common Average: $1.109.

New Aids to the Constructor

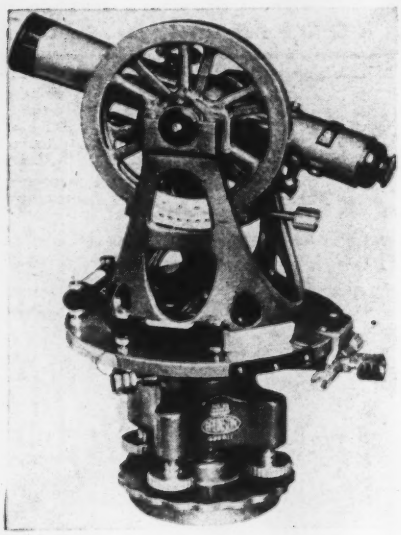
MANUFACTURERS' LATEST DEVELOPMENTS IN EQUIPMENT AND MATERIALS

Silicone Rubber— New applications for G-E silicone rubber as gaskets in high temperature equipment such as diesel engines, gas turbines and air compressors have been announced. It is available in extruded shapes, molded parts, sheet stock and fabricated stocks. —*Chemical Dept., General Electric Co., Pittsfield, Mass.*

Vibrating Machine — Model 750 with model 520 hopper, known as Vi-Brik-Crete is high-production machine to make concrete products at lowest possible cost and with moderate equipment expenditure. Its operation is based on the fluid characteristics of concrete when subjected to vibration of correct velocity and amplitude. Rigidity of machine structure and simplicity of design together with multiple molding capacity (7 brick) lower manufacturing costs. Concrete brick made upon this machine will have compressive strengths up to 100 percent greater than those of given mix by other methods. Absorption will be reduced as much as 35 percent. Bricks are molded on low-cost pallets of wood or steel. Upon completion of vibration and molding, they are instantly removed from machine on pallets for curing. Company claims that semi-automatic Vi-Brick-Crete will produce 28 concrete brick per min.—*R. S. Reed Corp., 53 Hoffman St., Three Rivers, Mich.*

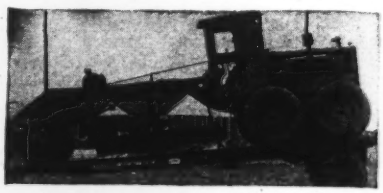
Packaged Power Unit— A new and revolutionary type of "packaged" power unit, to be known as Link-Belt electro-fluid drive, is presently available up to 20 hp. This neat, compact, motorized hydraulic combination consists of a general-purpose A-C induction motor flange-mounted on a sturdy housing containing a hydraulic coupling. Its output shaft may be direct connected to the driven machine or to a speed reducer unit or to driven machine through the medium of chain, gear or belt drives. The size of the motor is based on the running horsepower, not on starting requirements.

This power unit has numerous uses in connection with compressors, conveyors and varied construction operations. —*Link-Belt Co., 307 North Michigan Ave., Chicago 1, Ill.*

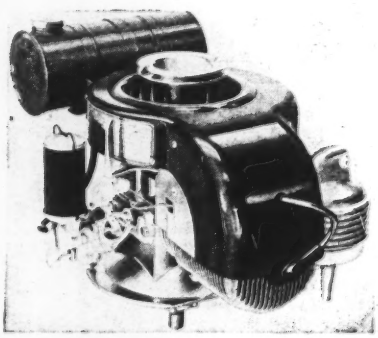


Transit — Vertical centers and horizontal axis of transit No. 50 are mounted on ball bearings, permitting a more rigid and tight instrument which operates freely and providing free turning in all temperatures, regardless of dust. Specifications given for telescope are: 10¼ in. long, erecting, internal focus, coated lenses, 22X power, 1¼-in. effective aperture, 4 seconds resolution, minimum focus 4¼ ft., Stadia 1:100.—*Brunson Instrument Co., 1405-07 Walnut, Kansas City, Mo.*

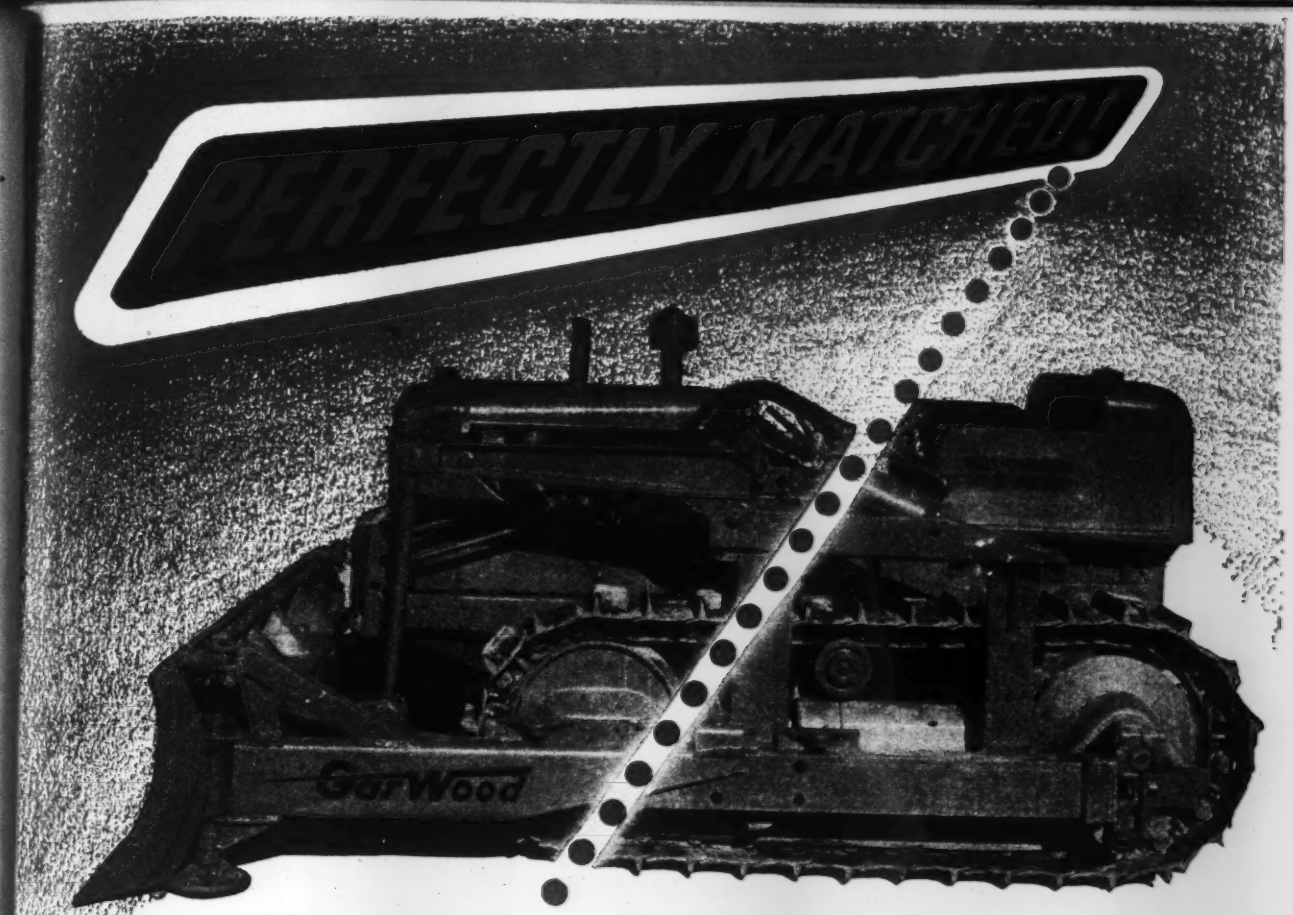
Dual Electrical Braking — A dual electrical braking system developed for heavy duty vehicles uses two independent braking systems. One of these, an electric retarder mounted on the drive shaft of the tractor and on a live axle of the trailer, employs the principle of the Eddy current brake. A separate system of conventional shoe brakes on all wheels is controlled by an electro-magnetic circuit operated by an ordinary brake pedal. For emergency stops, a micro switch on the brake pedal activates the retarder to full capacity at the instant the pedal is touched, regardless of the speed of the rheostat setting.—*Warner Electric Brake Co., Beloit, Wis.*



Self-Loading Float— By means of power winch mounted on truck, front end of self-loading float can be lowered to ramp position. Heavy loads can be driven on to trailer under their own power or pulled on by backing truck up to rear of trailer and using winch line. For traveling, trailer is pulled into coupling position again by winch line. One man can load and unload heavy load with self-loading float and winch.—*Hobbs Mfg. Co., Fort Worth, Tex.*



Gasoline Engine—New type of lightweight industrial gasoline engine, Model 1200D, is single-cylinder, two cycle, air-cooled type that weighs only 24 lb., yet develops rated 2.5 hp. at 2500 rpm. "Reverse-flow" scavenging system permits use of flat-top, non-deflection pistons. Directional control of incoming fuel charge is achieved through use of guide vanes in intake ports. Consequently, detonation resulting from hot spots on pistons tops is greatly reduced. Angled intake ports



FOR THE BRAND NEW ALLIS CHALMERS HD-5 TRACTOR

Specially Designed and Balanced Equipment by

GarWood

When it comes to *real*, down to earth *engineering* in small packages . . . you just can't beat the brand new, *specially* designed and balanced Gar Wood Equipment for the new Allis Chalmers HD-5 Tractor.

For here is a combination that's engineered and built expressly for *years* of dependable, rugged, smooth-functioning *work*. Perfectly-balanced earth-moving *brawn* that means more profit to you! And what's more . . . it's a combination that's *built to take a beating* . . . under the *worst* possible conditions . . . on the toughest jobs!

Want proof? Ask the men who've been using Gar Wood Road Building Equipment all over the world. Ask *them* about Gar Wood quality and dependable operation *when and where it counts*. Then consider: this is newly designed, exactly-engineered, quality-built Gar Wood Equipment.

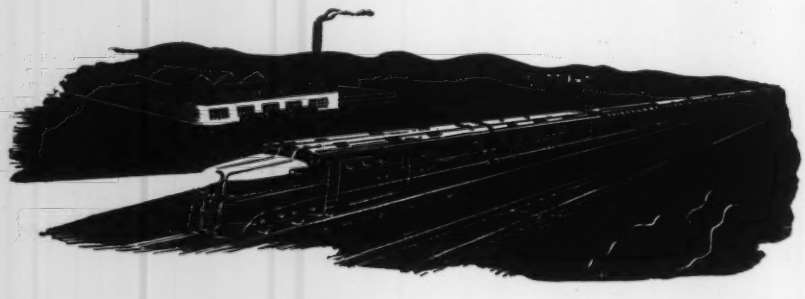
And then . . . for your own good . . . specify Gar Wood!

GAR WOOD GW INDUSTRIES

ROAD MACHINERY DIVISION

WAYNE, MICHIGAN

Want Fast, All Weather Transportation?

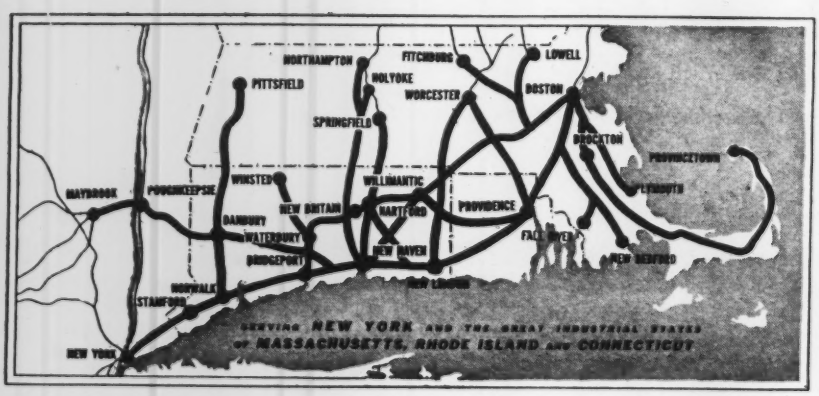


20,000,000 people are served by overnight freight service from New Haven Railroad Territory.

Coordinated railroad and highway freight service in Connecticut, Rhode Island and Massachusetts is second to none in America. *One-third* of the Nation may be reached by overnight railway express . . . and *more than half* of the Nation's population is only 24 hours by passenger train from Southern New England.

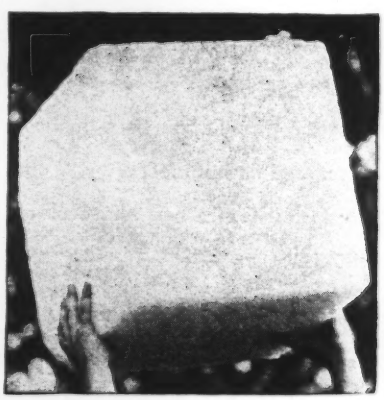
Dependable, all-weather train service is but one of many reasons why it pays to locate your industry along The New Haven Railroad. For a complete, concise resume of all the advantages available to you, write for a copy of "SOUTHERN NEW ENGLAND FOR TOMORROW'S INDUSTRY." Address: P. E. Benjamin, Mgr., Industrial Development, New Haven R. R., Room 201H, 80 Federal Street, Boston 10, Mass.

THE NEW HAVEN R. R.



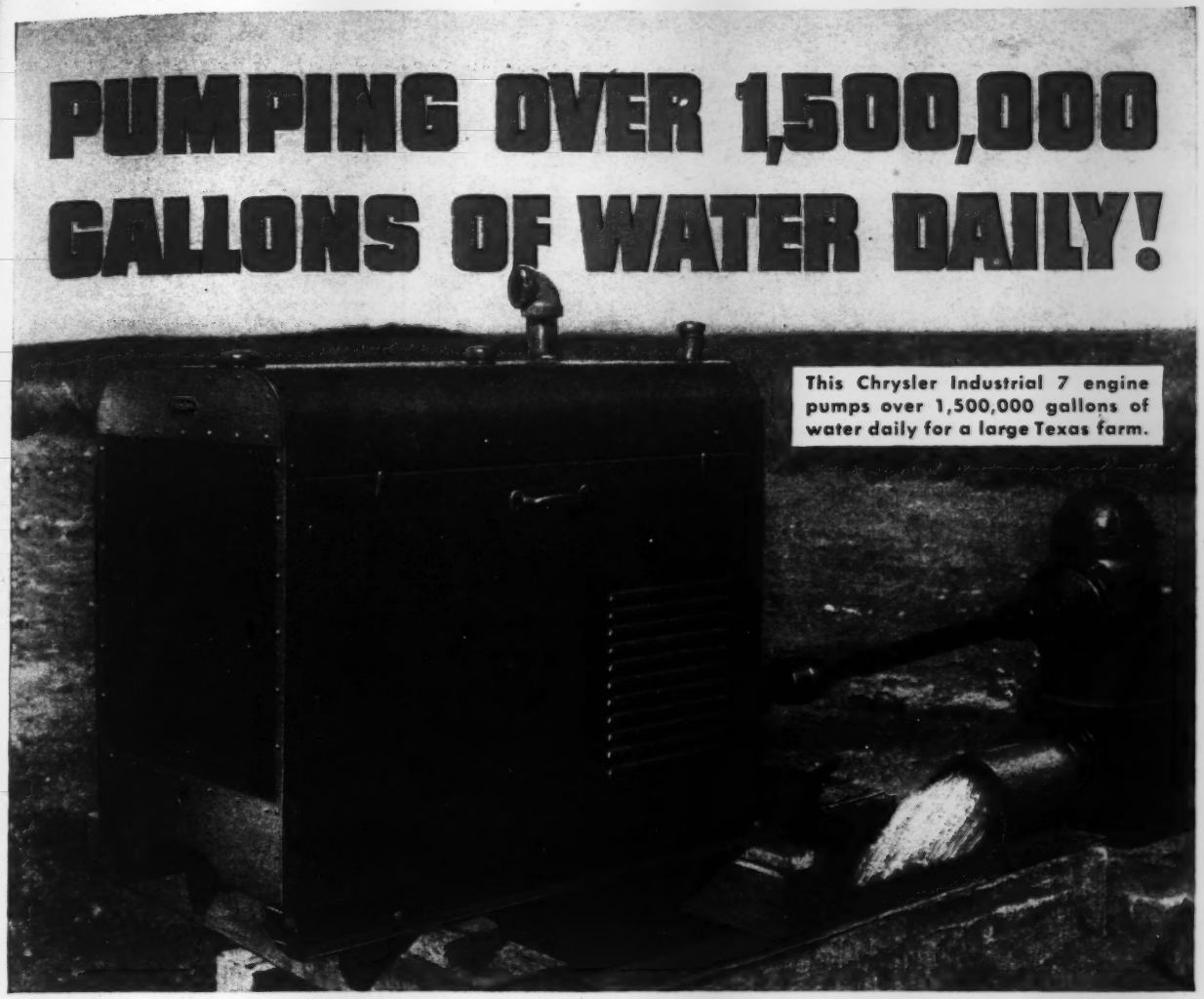
accurately control and focus intake fuel flow. All bearings are anti-friction type. Engine is air cooled and has high-tension flywheel magneto and rope starter.—*McCulloch Motors Corp., 6101 W. Century Blvd., Los Angeles 45, Calif.*

Rear Axles — Designed to give heavy-duty truck operators maximum pulling power and speed in the same truck, two new two-speed rear axles, S-300 and U-300, are announced. S-300 is intended for heavy-duty hauling on highways and city streets. Torque capacity is ample for modern high power engines. U-300 is for off-the-highway operations, using same engine torque, where still greater load-carrying capacity is required. Exclusive feature is built-in easy power shift for vacuum or compressed air actuation enabling driver to select the proper axle gear ratio. Axle housings in both axles are similar in design, made from highest grade malleable iron with inserted heat-treated alloy steel sleeves. Track on both axles is 72 in. ,with 11.00 x 20 tires on dual disk wheels with 12¾-in. spacing. Hubs for disk wheels are mounted on large-capacity wheel bearings spaced to obtain correct load distribution between inner and outer bearings.—*Timken-Detroit Axle Co., 100-400 Clark Ave., Detroit 32, Mich.*



Insulation — Styrofoam is Styron expanded forty times to produce a pure white, lightweight, multicellular mass of foam-like material with low thermal conductivity, good structural strength and resistance to moisture and water, mold and rot. Atmospheric exposure does not affect it adversely and, like Styron from which it is derived, it does not lose its strength at low tempera-

PUMPING OVER 1,500,000 GALLONS OF WATER DAILY!



This Chrysler Industrial 7 engine pumps over 1,500,000 gallons of water daily for a large Texas farm.

DESIGNED and built for rugged day-in, day-out operation, Chrysler Industrial Engines are pumping millions of gallons of water daily to irrigate many of America's large farms.

With their high compression, flexible horsepower characteristics, these engines are compact and portable because of low weight per horsepower. Simplicity of design makes them readily accessible.

These features plus Chrysler Superfinishing of moving parts assure a smooth, economical and dependable flow of power for the farm and many types of industrial application.

Send coupon for the Industrial Engine catalog giving complete information on engines and power units.

Some Applications of Chrysler Industrial Power

Arc Welders	Industrial Lift Trucks
Air Compressors	Industrial Pumps
Booster Pumps	Industrial Tractors
Concrete Mixers	Mechanical Shovels
Cranes	Motor Coaches
Crane Carriers	Portable Sawmills
Crane Loaders	Portable Well Drillers
Farm Tractors	Road Rollers
Fire Pumps	Self-propelled Farm Combines
Fuel Oil Pumps	Soil Pulverizers
Gang Mowers	Street Flushers
Generator Sets	Winches

CHRYSLER
INDUSTRIAL ENGINES

Horsepower with a Pedigree

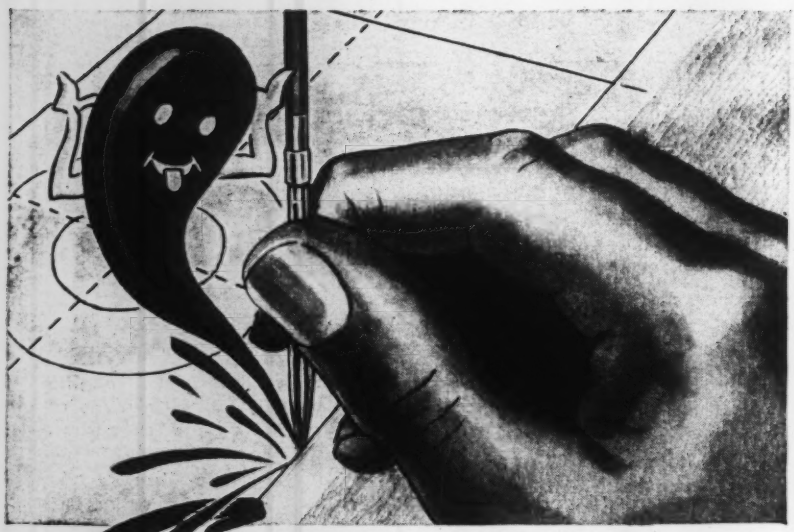
Industrial Engine Division, Chrysler Corp.
12200 East Jefferson, Detroit 31, Michigan

Please send the Chrysler Industrial Engine Catalog.

Name_____

Address_____

1 City_____ State_____



Splat!

● Time lost, a distinct bluish tint to nearby air . . . and all because of a pinhole or thick thread in a piece of inferior tracing cloth.

Arkwright guards against accidents like this by making sure all thick threads are removed from the base cloth even before it is bleached. You'll find one safeguard like this after another – all the way through Arkwright's special *mechanical* process – to prevent pinholes and other irregularities, and to guarantee that *every* roll comes to you with a uniform surface and lasting translucency.

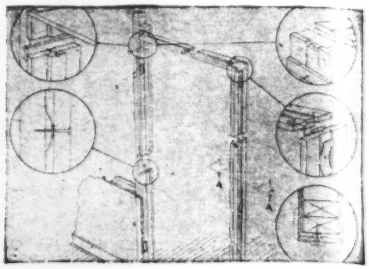
See for yourself how much better Arkwright is. Send for free working samples. Sold by leading drawing material dealers everywhere. Arkwright Finishing Co., Providence, Rhode Island.

All Arkwright Tracing Cloths have these 6 important advantages

1 *Erasures re-ink without "feathering"*
2 *Prints are always sharp and clean*
3 *Tracings never discolor or become brittle*
4 *No surface oils, soaps or waxes to dry out*
5 *No pinholes or thick threads*
6 *Mechanical processing creates permanent transparency*

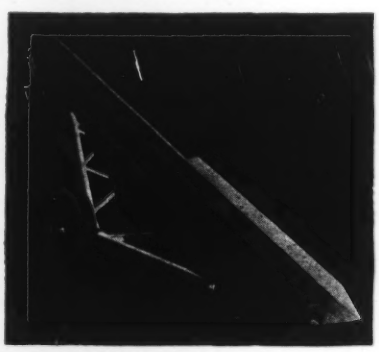
Arkwright
TRACING CLOTHS
AMERICA'S STANDARD FOR OVER 25 YEARS

tures. It shows no tendency to disintegrate or settle.—*Dow Chemical Co., Midland, Mich.*



Door Jamb—Tru-sized door jamb is said to cut installation time from 1-1½ hr. to 8-10 min. Completely built at factory, there are only three precision-milled pieces to handle. It eliminates work of making dados, placing and fitting blocks, etc. Packaged two to a bundle in protective paper wrapping, jambs come from the factory complete with all necessary hardware and full instructions for installation. Entire process of plumbing and fitting jamb is accomplished by increasing or decreasing pressure of screws against tension of leaf springs.—*Wheeler Osgood Co., Tacoma, Wash.*

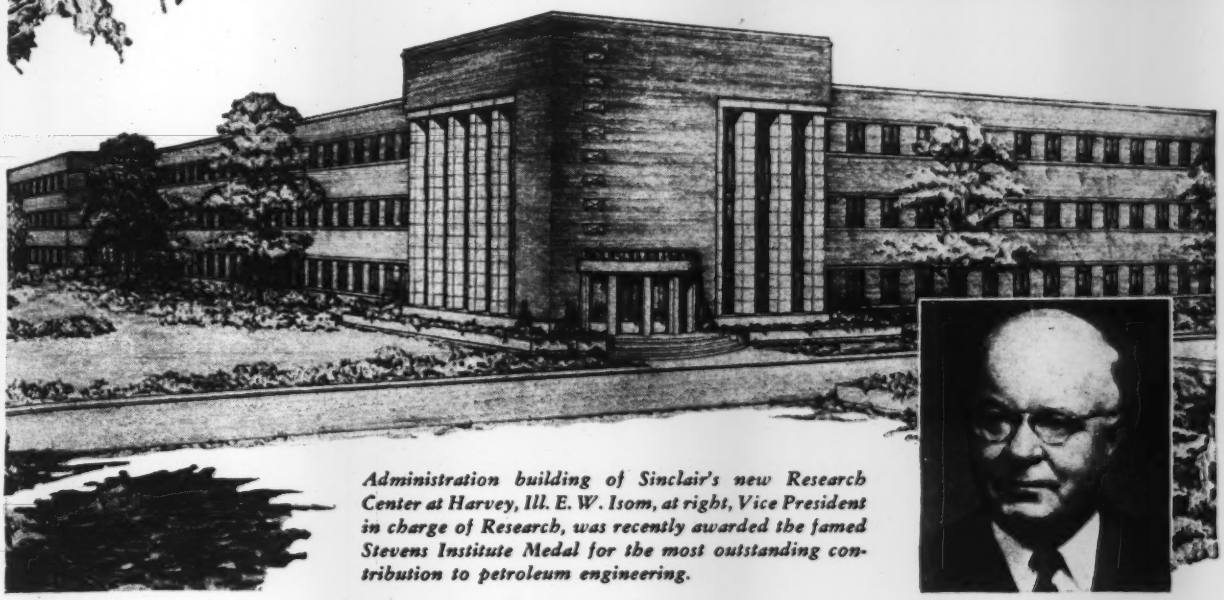
Heavy-Duty Vise — A quick-action heavy duty vise known as the Grand Vise Master, incorporates many outstanding advantages. It closes instantly with push on free jaw, and opens automatically by trigger release on its spring action. The vise is equipped with "Double Bite" steel pipe jaws integral with the body and it completely revolves full 360 deg. on base with double swivel friction type lock-up.—*Grand Specialties Co., Grand Ave at Gray St., Chicago 22, Ill.*



Loading Conveyor — Conveyall is endless cleated belt loader, which can be operated by one man. It will handle from 300-mesh material up to and including large-size cartons. Loading chute can be adjusted to variable

Outstanding Ability

. . . to solve your lubrication problems



Administration building of Sinclair's new Research Center at Harvey, Ill. E. W. Isom, at right, Vice President in charge of Research, was recently awarded the famed Stevens Institute Medal for the most outstanding contribution to petroleum engineering.

Sinclair is completing a new $4,000,000 petroleum research and development laboratory at Harvey, Ill. This great research center — to be the most modern and best equipped in the industry — climaxes more than 30 years of consistent achievement in the development of superior products for the solution of your most difficult lubrication problems.

The outstanding skill and vast technical knowledge of recognized experts in the petroleum field will continue to serve you at Harvey as they have for so many years at East Chicago.

For tested, proven lubricants . . . *designed by special research for specific industrial application* . . . rely on *Research-Wise Sinclair.*

Sinclair Automotive Lubricants

For Engines:

OPALINE MOTOR OIL

OPALINE TBT MOTOR OIL

(For severe service)

TENOL (Heavy Duty — For Diesels)

For Gears:

OPALINE GEAR LUBRICANTS

For Chassis:

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For Wheel Bearings:

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Lubricants for Industry

FINEST CRUDES + EXPERT RESEARCH and MANUFACTURING CONTROL = OUTSTANDING PERFORMANCE

BRIGGS & STRATTON
ENGINES

A Re-Statement of Policy

Loyalty to our customers of long standing . . . their needs come first.

Production at highest possible levels . . . limited only by availability of materials that meet our exacting specifications.

No deviation from Briggs & Stratton high standards of engineering, manufacture and inspection.

Expansion of our world-wide organization of Authorized Service Stations . . . staffed with skilled, factory-trained personnel . . . and adequately supplied with repair parts.

These policies, re-affirmed now, are continued assurance to equipment manufacturers, dealers and users that "It's powered RIGHT . . . when it's powered by Briggs & Stratton".

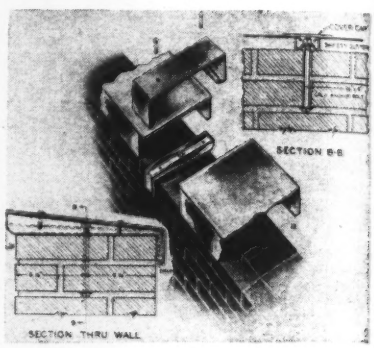
BRIGGS & STRATTON CORPORATION
Milwaukee 1, Wisconsin, U. S. A.

Air-Cooled Power

4 CYCLE
BRIGGS & STRATTON
GASOLINE ENGINES

heights.—*Bosworth Engineering Co., 6723 Denison Ave., Cleveland, 2, Ohio.*

Fork Truck — A new fork-type power industrial truck with an elevating reach of 18 ft. above floor level is unusually compact, with increased speed and flexibility for maneuvering, lifting and lowering loads. The new truck picks up loads on its bare fork or on pallets; its capacity is rated at 4,000 lb., for lifting to a height of 11 ft. and 3,000 lb. to 18 ft. It is electrically driven, with three separate motors; one for traveling, one for operating the elevating mechanism, and the third for tilting the upright columns. Tilting limit is 15 deg. backward and 5 deg. forward from vertical.—*Elwell-Parker Electric Co., 4205 St. Clair Ave., Cleveland 14, Ohio.*



Metal Coping— Simple in construction and easy to handle, the Goodwin lifetime metal prefabricated coping, formed of four metal parts, can be quickly assembled and installed, is light in weight, needs no caulking or resealing and requires no special tools for erection. Production is being concentrated on the 12½ and 8½ in. widths for standard walls in aluminum, copper, monel, stainless steel, etc.

Installation begins with anchor bolts set in the mortar when the two top rows of bricks are laid in a new wall; a hole may be drilled and anchor bolt set in existing walls. A formed metal channel fastens to this anchor bolt and the longitudinal sheets with crimped edges hook over the gutter bar, forming a tight joint, over which slides the safety cover. There is ample room for expansion and contraction. Should water creep beneath the seam, the extruded metal gutter bar easily disposes of it. —*Overly Manufacturing Co., Greensburg, Pa.*

Nylon Rods—Nylon rods which can be machined accurately, made of DuPont's FM-1 nylon molding powder, result from a new technique to extrude

I look for all 8 to get t.f.e.

True Fastener Economy

It is the many costs of using a fastener that count . . . not just the initial price. *True Fastener Economy* is the lowest *total* cost for fastener selection, purchase, assembly and holding power.

YOU GET t.f.e. WHEN YOU . . .

1. Reduce building time to a minimum by savings through use of quick-assembling bolts and nuts

2. Make your men happier by giving them fasteners that make their work easier and safer

3. Reduce the number and size of fasteners by proper design

4. Use the fastening method—bolts and nuts—which involves minimum indirect labor, noise and confusion

5. Purchase maximum holding power by capitalizing upon the high residual tension set up by bolt-and-nut fastening

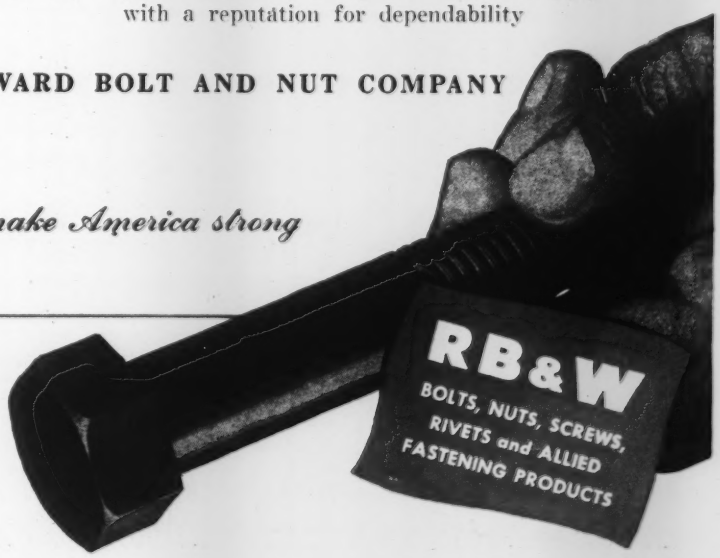
6. Simplify inventories by standardizing on fewer types and sizes of fasteners

7. Save purchasing time by buying larger quantities from one supplier's complete line

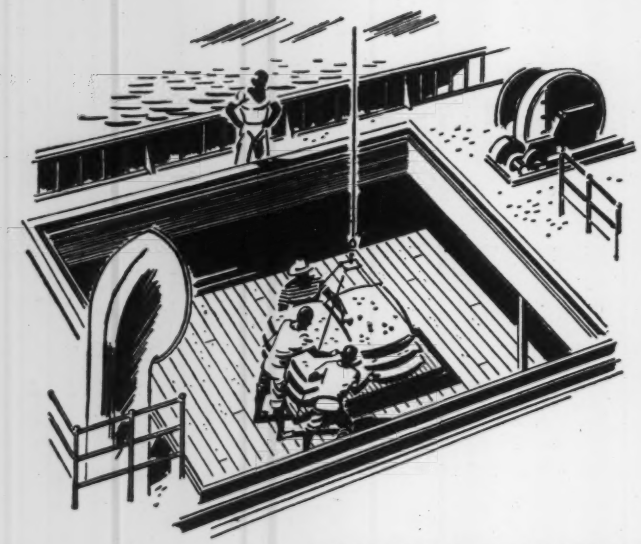
8. Assure yourself a satisfactory fastener performance by using a source of supply with a reputation for dependability

RUSSELL, BURDSALL & WARD BOLT AND NUT COMPANY

102 years making strong
the things that make America strong



Plants at Port Chester, N. Y., Coraopolis, Pa., Rock Falls, Ill., Los Angeles, Calif. Additional sales offices at Philadelphia, Detroit, Chicago, Chattanooga, Portland, Seattle. Distributors from coast to coast. By ordering through your distributor, you can get prompt service for your normal needs from his stocks. *Also*—the industry's most complete, easiest-to-use catalog.



WOOD DECKS
are Easy on Bare Feet

Natives don't get a "hot foot" on ships decked with Wolmanized Lumber* for service in the tropics. Wood doesn't scorch bare feet and cargo holds insulated with this wood are cooler.

Pressure treatment with Wolman Salts* preservative makes wood highly resistant to decay and termite attack. Thus wood, best able to withstand the punishment materials must take aboard ship, is given this added ability.

What a combination! Wood for greater comfort and cargo safety, and pressure treatment for long life and low upkeep costs. There's an American Lumber wood treatment to meet your needs.

AMERICAN LUMBER & TREATING COMPANY

CREOSOTING

FLAMEPROOFING

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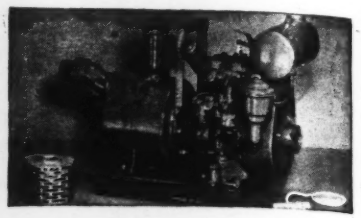
*Registered trademarks

1649 McCORMICK BUILDING, CHICAGO 4, ILLINOIS

the plastic. The rods range from 1/8 to 2 in. in dia., and from 2 to 4 ft. in length, and can be used in making valve seats, gaskets, etc.—*The Polymer Corp., Reading, Pa.*



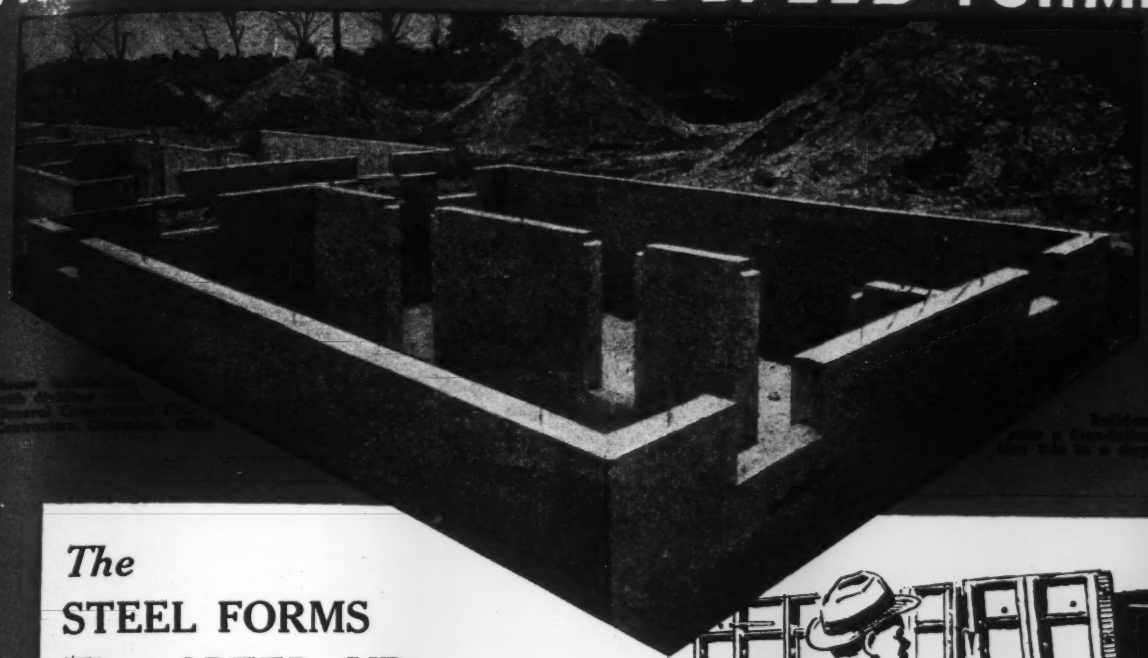
Centrifugal Pumps—Self-contained, self-priming centrifugal contractor's pumps, known as Humdingers, are available in sizes from 1½ to 8 in., with 4,500- to 125,000-g.p.m. capacities. Model 4½M, shown above, is 1½ in. unit. Recently perfected priming device utilized in this model eliminates necessity of troublesome automatic valves, counterweights, etc., and guarantees full pumping capacities in as little as 15 sec. Featuring only one moving part, it moves more than 2 tons of water per hour during continuous operation.—*Ralph B. Carter Co., Hackensack, N. J.*

Truck Tire— Production of Road Lug tire in sizes 7.00-20 through 12.00-24 has begun and ultimately sizes 13.00-24 and 14.00-24 will be available. Road Lug is particularly suitable for use under conditions where heavy loads must be hauled out on rocky, rutty or stump - obstructed roads to surfaced highways.

It is claimed that it is capable of resisting cutting and bruising, providing traction in soggy going and delivering exceptional mileage on improved highways in addition. Tires are constructed with rayon cord carcass, tread and sidewalls with natural rubber content equal to prewar tires of same size, extra heavy layers of cushion rubber between plies and extra heavy rayon breaker. All sizes have multiple beads of high carbon steel wire.—*Goodyear Tire & Rubber Co., Akron, Ohio.*

Thru-Wall Copper Flashing—Embodies many original features: Has saw-tooth corrugations that form mechanical key bond in mortar, vertically and laterally; perfect drainage; provision for expansion and contraction;

ATLAS LABOR-SAVING *SPEED* FORMS



The STEEL FORMS That *SPEED* UP CONCRETE CONSTRUCTION

Builders and engineers make savings of 25 to 50%, and do a better job in less time with Atlas Speed Forms—Much better and faster than with plywood.

Easily and speedily erected, stripped and moved. No studs or joists needed. Light-weight—anyone can handle them. Ruggedly built of steel—good for indefinite use without repair. *Form Cost per sq. ft. per use less than one cent.*

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Atlas SPEED forms line up straight and true. • Easy to set up, move and strip • Adjustable to suit any condition • Interchangeable —can be used for walls or floors—Smooth Finish—no knot or grain marks—Nothing to remove.

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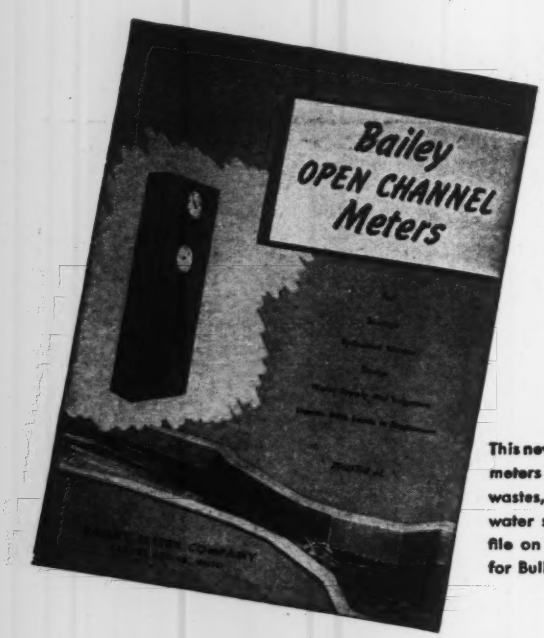

This new publication describing meters for sewage, industrial wastes, sludge and irrigation water should be part of your file on flow measurement. Ask for Bulletin 62.

FEATURES of BAILEY OPEN CHANNEL METERS

1. Low Cost
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3. Easy to Maintain
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8. Totalize Multiple Flows
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VENTURI TUBES, FLUMES, WEIRS, NOZZLES, ORIFICES • DIRECT MECHANICAL AND REMOTELY LOCATED REGISTERS • AIR-OPERATED, ELECTRONIC AND ELECTRIC CONTROLS.

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SOIL AND ROCK EXPLORATION

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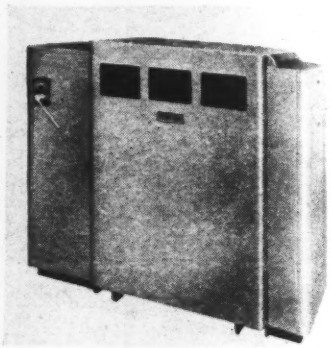
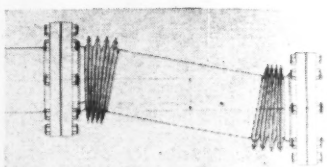
interlocking overlap that requires no soldering; stiff counterflashing face that hugs the wall tightly after the base flashing has been installed; and ease with which it may be bent by sheet metal worker. It is designed to prevent leaks and seepage in building walls, streaks, stains and efflorescence, and rusting of spandrel beams. It is made in sheet form in standard widths up to and including 34-in., widths and 6-ft. lengths.—*Chase Brass & Copper Co., 236 Grand St., Waterbury 91, Conn.*



Compact Unit Substation— High voltage incoming line, transformer, and low voltage feeder sections are combined in one compact assembly in a new All-In-One unit substation. Installation. is simplified, as the units are delivered ready to connect.

This substation has ratings of 100, 150, 200, and 300 kva, 3 phase, 60 cycles. Choice of combinations of different types of transformers and high low voltage equipment make it suitable for a wide range of applications.—*Wagner Electric Corp. 6400 Plymouth Ave., St. Louis 14, Mo.*



Offset Joints—A standard line of MagniLastic offset joints fills the need for a standard flexible unit for joining pipe terminals that are out of line or offset. The joint is constructed with an equal number of expansion flanges on either end of an insert section.

Offset joints are supplies with bellows flanges from any of the Magni-Lastic standard expansion joint series which includes pressures from vacuum to 1,000 psi, pipe sizes from ½ to 24 in. and temperatures from minus 300 to plus 1,600 deg. F. Joints of stainless steel, Monel, Inconel and copper cover all common corrosive conditions.—*Magni-Lastic, a division of Cook Electric Co., 2700 Southport, Chicago 14.*

LIMA Again in 1947

LIMA enters 1947 the pacemaker among shovels, draglines and cranes. Efficient high speed operation of LIMA machines continues to smash performance records everywhere. In brick plants, quarries, sand and gravel pits, coal and metal mines, lumber, general construction, etc., LIMA is giving the kind of service that users want—service that steps up production and delivers big output at low cost. LIMA shovels are built in capacities ranging from 3/4 yard to 5 yards and crane capacities range from 13 tons to 100 tons. Bulletins sent on request.

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See ad on page 121 for list of equipment in each line

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Alaska, Anchorage, Airport Mach. & Storage Co.
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Little Rock, R. A. Young & Son
Cal., L. A. Golden State Equip. Co.
San Francisco, Coast Equip. Co.
Colo., Denver, Power Equipment Co.
Conn., New Haven, Wilhelm-Davies Co., Inc.
Fla., Miami, Allied Equip., Inc.
Orlando, Highway Equipment and Supply Co.
Tampa, Epperson & Company
Ga., Atlanta, Tractor & Machinery Company
Ida., Boise, Olson Manufacturing Co.
Ill., Chicago, Chicago Construction Equip. Co.
Ill., Chicago, Thomas Hoist Co.
Iowa, Cedar Rapids, McNall Mach. & Supply Co.
Ill., Chicago, J. A. Roche
Ky., Harlan, Crossborn Equip. & Supply Co.
Louisville, Williams Tractor Co.
Maine, Portland, Maine Truck-Tractor Co.
Mass., Allston, Boston, Clark-Wilcox Co.
Mich., Muskegon, Lakeshore Machy. & Supply Co.
Minn., Minneapolis, Phillippi-Murphy Equip. Co.
Miss., Jackson, Jackson Road Equip. Co.
Mo., Clayton, The Howard Corporation
St. Louis, W. H. Reaves
Montana, Billings, Interstate Truck & Equip. Co.
Helena, Caird Eng. Works
Nevada, Elko, C. W. Paul Hardware
N. J., No. Bergen, American Air Comp. Corp.
N. M., Albuquerque, Bud Fisher Co.
Roswell, Smith Machy. Co.
N. Y., Albany, Milton-Hale Machinery Co.
New York, Hodge & Hammond, Inc.
New York, Railroad Materials Corp.
Olean, Freeborn Equip. Co.
Syracuse, Milton-Hale Mach. Co.
N. C., Raleigh, Smith Equip. Co.
N. D., Fargo, Smith Commercial Body Works, Inc.
Ohio, Cincinnati, Carroll-Edwards & Co.
Dayton, Carroll Edwards & Co.
Okla., Oklahoma City, Townsco Equip. Co.
Oregon, Portland Andrews Machinery
Pa., Wilkes-Barre, Ensminger & Co.
Oil City, Freeborn Equip. Co.
Mechanicsburg, American Equip. Corp.
Philadelphia, Metalweld, Inc.
S. C., Columbia, Smith Equipment Co.
Tenn., Knoxville, Dempster Bros., Inc.
Memphis, Independent Tractor Co.
Nashville, Dempster Bros., Inc.
Tex., Amarillo, T. W. Carpenter Equip. Co.
Dallas, Shaw Equip. Co.
Houston, Contractors Equip. Sales & Service Corp.
San Antonio, Patten Machy. Co.
Tyler, D. M. McClure Equip. Co.
Utah, Salt Lake City, J. K. Wheeler Mach. Co.
Vt., Barre, A. M. Flanders, Inc.
Wash., Spokane, Andrews Equip. Service
Va., Richmond, Highway Machy. and Supply Co.
W. Va., Charleston, Allied Equip. Co.
Wisc., Milwaukee, Drott Tractor Co., Inc.

Ransome Distributors

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La., New Orleans, Ole K. Olson Co.
Md., Baltimore, Stuart M. Christhilf & Co.
Mich., Detroit, T. G. Abrams
Mich., Detroit, Welding Equip. & Supply Co.
N. Y., Buffalo, Murray Equip. Co
N. Y., Rochester, B-G Equip. Co.
Pa., Pittsburgh, Arrow Supply Company
O., Cleveland, H. B. Fuller Equip. Co.

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Md., Baltimore, D. C. Elphinstone, Inc.
Mass., Cambridge, Field Mach. Company
Mich., Detroit, W. H. Anderson Co., Inc.
Flint, Granader-Hall & Co.
Mo., Kansas City, Mach. & Supplies Co.
N. Y., Buffalo, Dow & Co., Inc.
New York, Air Compressor Rental and Sales
O., Cleveland, Gibson-Stewart Co.
Toledo, The Kilcorse Mach. Co.
Pa., Allentown, H. N. Crowder, Jr., Inc.
Pittsburgh, Atlas Equip. Corp.
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Washington, Seattle, Star Machinery Co.
Wyoming, Cheyenne, Wilson Equip. & Supply Co.

Blue Brute Dozers

Worthington Pump and Machinery Corp.
Worthington-Ransome Construction Equipment Division
Holyoke, Massachusetts

Manufacturers' Publications

Control Valves — (36-p. bulletin) Features color page showing various identifying enamel finishes offered on Stabilflo Valves, corresponding with color code of American Standards Association; plates and tables of specifications for control valves, needle type valves, poppet valves and butterfly valve; separate sections on Vernier Valvactor for high-accuracy positioning of valve plungers, and on air switches and sub-panels for remote valve control. Appendix contains information on computing valve sizes, with tables and formulae for determining size of correct valve for contemplated installation. Air filter sets, ventilating dampers, and other pertinent accessory equipment are illustrated and described.—*Foxboro Co., Foxboro, Mass.*

Two-Stage Pumps—(8-p. bulletin) Describes company's high efficiency ball bearing type DMD two-stage pumps, which are suitable in all clear water services where pressures of 100-170 lb. are required. Selection tables are included.—*Economy Pumps, Inc., Hamilton, Ohio.*

Metallizing Process—(86-p. pocket-size handbook, fourth edition) Contains up-to-the-minute data on preparation of surfaces, metallizing technique and finishing procedure and complete information on corrosion resistance, specific gravity, hardness, bond strength, tensile strength and relative shrinkage. It is profusely illustrated with pictures, drawings, diagrams, charts and graphs. Price is $2.—*Metallizing Engineering Co., Inc., 38-14 30th St., Long Island City, N. Y.*

Automatic Clarifiers—8-p. product manual) Describes use of oil clarifiers on all sizes of trucks, buses and tractors, as well as unit for diesel engines. Size recommendations and specifications are given.—*Briggs Filtration Co., Bethesda 14, Md.*

Industrial Packing—(Illustrated folder) Describes various types of metal packings and outlines advantages of packings made to fit standard stuffing boxes.—*France Packing Co., 6512 State Road, Philadelphia 35, Pa.*

Soda Ash—(64-p. bulletin) Contains chapters on properties of soda ash, bulk shipments, storage, conveying and elevating, unloading of bulk, unloading of bags and barrels, weighing, proportioning and feeding devices, sampling and analysis, precautions and conversion tables—*Solvay Sales Corp., 40 Rector St., New York 6, N. Y.*

Diesel Engine Cooling Systems—(20-p. booklet) Valuable addition to reference library of anyone interested in stationary diesel engine efficiency and lower operating cost. Profusely illustrated with pictures, diagrams and blueprints, it shows how water jacket scale, overheating, costly break-downs, and insurance rates can be greatly reduced or entirely eliminated.—*Binks Manufacturing Co., 3114-40 Carroll Ave., Chicago 12, Ill.*

Duplex Plant—(8-p. booklet) Explains in detail how 45-VE duplex crushing and screening plant with diesel and electric drives is constructed, how simplified drives are arranged, and gives complete specifications. Special emphasis is given to features which make it possible to secure unusual portability and maneuverability of high capacity plant. Reduction in weight and savings in mechanical maintenance costs accomplished by electric drive are pointed out.—*Pioneer Engineering Works, 1515 Central Ave., Minneapolis 13, Minn.*

Foundation Panel—(8-p. folder) Describes system of forms for construction of foundations and small homes for all types of commercial structures where story height forms are desired.—*Universal Form Clamp Co., 1238 N. Kostner Ave., Chicago 51, Ill.*

Floodlights — (Two-color folder) Covers Nite-Hawk portable floodlight and searchlight units and shows application of power units with Thor portable electric tools. Another illustrated folder describes company's line of diesel electric generating plants.—*Winpower Mfg. Co., Newton, Iowa.*

Power Shovels—(36-p. booklet) Describes, illustrates and gives specifications for Model 70 units, including power shovels, trench hoes, draglines and cranes. Chart of material weights is feature.—*Buckeye Traction Ditcher Co., Findlay, Ohio.*

Protective Coatings (Visual index) Shows industrial applications for the different types of "Bitumastic" protective coatings. Center page contains large composite drawing of factory showing where Bitumastic and Bituplastic products can be used to advantage in prevention of corrosion.

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You can make short work of the toughest rock with this Blue Brute combination. Start with the New Worthington Wagon Drill, that swings its WD-40 Drifter into action at any angle . . . a fast, powerful drilling machine with a lot of improvements that make it the most versatile performer in its field.

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And for always dependable power — a Worthington Portable Compressor. The 315′ is typical. Engine and compressor are joined in a single housing, with three-point suspension, and both are lubricated with full force feed . . . while the easy-breathing Feather* Valves get *all* the air power out of every drop of fuel — gently, positively.

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*Reg. U. S. Pat. Off.

H6-13

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Your Blue Brute Distributor will be glad to show you how Worthington-Ransome construction equipment will put your planning on a profitable basis. His name is listed on Page 120.

RANSOME EQUIPMENT

Pavers, Portable and Stationary Mixers, Truck Mixers, Pneumatic Placing and Grouting Equipment and Accessories.

WORTHINGTON EQUIPMENT

Gasoline and Diesel Driven Portable Compressors, Rock Drills, Air Tools, Self-Priming Centrifugal Pumps and Accessories.

Get more WORTH from air with WORTHINGTON

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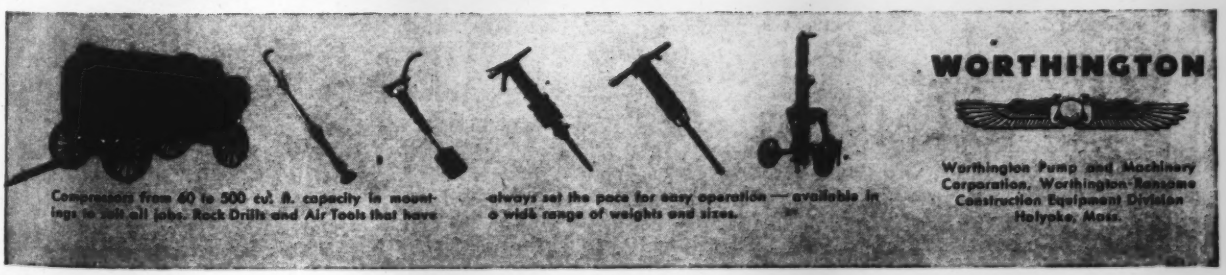
Compressors from 60 to 500 cu. ft. capacity in mountings to suit all jobs. Rock Drills and Air Tools that have
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WORTHINGTON
Worthington Pump and Machinery Corporation, Worthington-Ransome Construction Equipment Division
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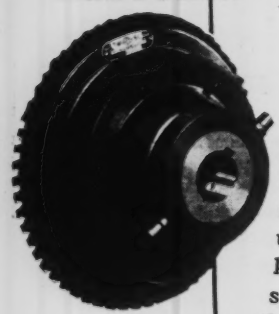
Built to withstand SHOCK



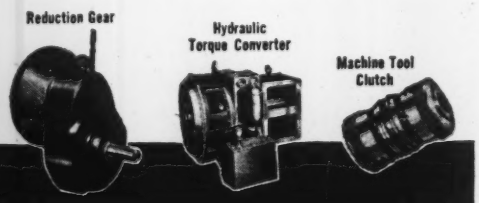
Upper: Twin Disc Power Take-off.

Lower: Model EH Heavy-duty Clutch.

The greatest possible ruggedness . . . the ability to stand the rough usage and shocks to which construction equipment is subjected . . . has been built into Twin Disc Heavy-duty Clutches and Power Take-off Units.

The Twin Disc Clutch Company incorporates the latest features of balanced design in their clutches. Constant testing, refinement, and observation of the units at work in the field and laboratory keep Twin Disc Heavy-duty Clutches in step with the latest developments made by machinery builders.

Balanced design . . . fine materials . . . careful workmanship, backed by 28 years of experience in the field, enable the Twin Disc Clutch Company to produce the sturdy, rugged clutches which give efficient performance and trouble-free life in jobs where the going is the toughest. TWIN DISC CLUTCH COMPANY, Racine, Wisconsin (Hydraulic Division, Rockford, Illinois).



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Guide provides handy checking arrangement whereby plant managers can readily determine correct coating to protect buildings and plant equipment. —*Wailes Dove-Hermiston Corp., Westfield, N. J.*

Flexible Shaft Machines—(16-p., two-color folder) Describes new additions to and present models of flexible shaft machines, high-speed grinders, tools and accessories.—*Wyzenbeek & Staff, Inc., 838 W. Hubbard St., Chicago 22, Ill.*

Truck Transportation—New plan, termed "Continuing Control System of Truck Management", presents detailed system for increasing transportation efficiency of all owners of motor trucks. Complete instructions and material for putting system into effect are available. —*The White Motor Co., Cleveland 1, Ohio.*

Protective Paints—(8-p. bulletin) Describes penetration, protective paints that are said to cut practical painting time from hours to minutes Products covered include rust preventive oil paint, aluminum paint, enamel, and rubber coats.—*Wilbur & Williams Co., Greenleaf & Leon St, Boston 15, Mass.*

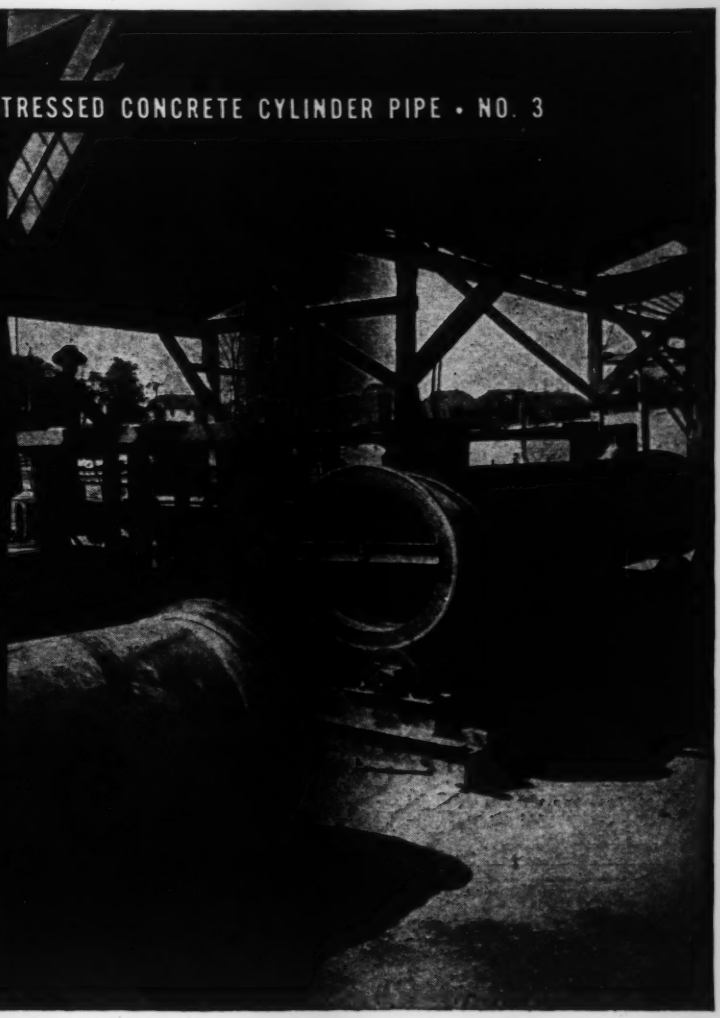
Building Products Directory—(28 p.) Contains classified history of products and services of Producers' Council members; gives locations of members' sales representatives who are equipped to furnish technical and product information; and lists national offices and representatives of members. Directories are being distributed to architectural and engineering offices, federal, state and local government construction offices, and selected general contractors, specialized contractors, home builders, and building management firms.—*The Producers' Council, Inc., 815-15th St., N. W., Washington 5, D. C.*

Industrial Safety Charts — Issued monthly, as part of safety program of Division of Labor Standards, U. S. Department of Labor, safety charts for 1946 cover: Punch presses, gas welding and cutting, hand trucks, hammers, traveling cranes, scaffolds, metal shears and brakes, freight elevators, cold chisels, electrical hazards for electricians, compressed gas cylinder and jointers and planers. Priced at 5 cents each or $3.75 per 100, copies are available from *Superintendent of Documents, Government Printing Office, Washington 25, D. C.*

Lamps—(76-p. technical treatise) Contains cream of technical data gathered by C. E. Weitz from wide range of bulletins and articles published by engineering division of G. E.

ADVANTAGES OF PRESTRESSED CONCRETE CYLINDER PIPE • NO. 3

Greater Elasticity



● Lock Joint Prestressed Concrete Cylinder Pipe has many advantages . . . and among its most important qualities is GREATER ELASTICITY.

Tests have proven that *prestressing* produces elastic properties in a reinforced concrete structure, previously unattainable with conventional designs, and it is only through *prestressing* that the wider range of elastic properties of high tensile wire can be used to the greatest advantage. The winding of the wire under tension around the "core" causes an initial compression in the concrete lining, thereby giving the finished pipe a much greater range of elasticity to withstand internal pressure, water hammer and overloads.

During the past few years, the Lock Joint Pipe Company has installed hundreds of thousands of feet of Prestressed Concrete Cylinder Pipe with several hundreds of thousands of feet now under contract. When you specify this high pressure pipe you can count 100% on strength, economy and performance.

A Hazen-Williams Hydraulic Slide Rule will gladly be sent upon request with our compliments.

LOCK JOINT Reinforced Concrete PRESSURE PIPE

LOCK JOINT PIPE COMPANY

Established 1905

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SCOPE OF SERVICES { *Lock Joint Pipe Company specializes in the manufacture and installation of Reinforced Concrete Pressure Pipe for Water Supply and Distribution Mains in a wide range of diameters as well as Concrete Pipe of all types for Sanitary Sewers, Storm Drains, Culverts and Subaqueous lines.*

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Of pressure-formed construction, with no bolts, rivets or angle irons to loosen, every Mitco panel is a rugged, integral unit that will support heavy loads without lateral deflection.

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You can gain independence from coal—and many other advantages—when you entrust your haulage to modern Diesel powered Davenports. These long lived, sturdy power units give you 100% availability, are easy-to-operate, flexible and ECONOMICAL. Modern Davenports deserve your serious consideration.

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We will be pleased to send you a Survey Data Sheet to enable you to prepare, for our engineers, a complete description of your haulage conditions. In turn we will submit a reliable recommendation covering the size and type of locomotive that will perform your work most satisfactorily—a direct step toward more efficient haulage at lowest ton-mile costs.

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lamp department. It features latest lamp developments and their practical applications to host of fields in commerce, industry and home. Its contents page lists more than 40 lamp topics, including lamp economics, temperatures, voltages, auxiliary equipments, germicidal, infrared, sunlamps and glow lamps. Copiously illustrated with photos, diagrams and charts, it is priced at 40 cents.—*General Electric Lamp Department, Nela Park, Cleveland, Ohio.*

Perforated Metals—(128-p., illustrated catalog) Describes and illustrates types and sizes of perforations, including round, square, square-round, diamond and slot. Screens and fabricated metals are also covered. Numerous tables furnish useful information.—*Hendrick Mfg. Co., Carbondale, Pa.*

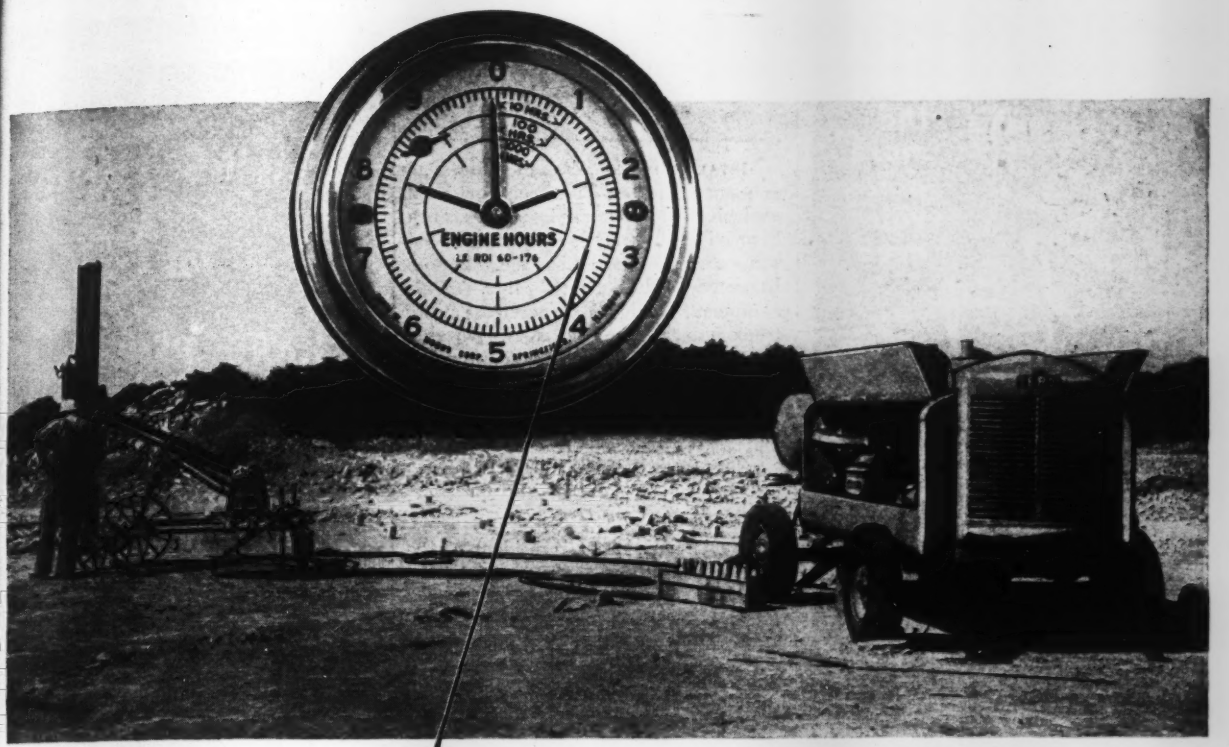
Tunnel Forms—(8-p. file folder) Describes and illustrates traveling steel forms for tunnels, sewers, conduits and walls, and special tunnel equipment—shields, air locks and jumbos.—*Robert S. Mayo, Construction Engineer, Lancaster, Pa.*

Sewage Pumps—(32-p. data book, revised edition) Gives complete construction details, dimensions and installation and operating data on vertical and horizontal sewage pumps, self-priming sewage pumps, sewage ejectors, and single suction sludge pumps for general service and special liquors. Included are typical specifications covering non-clogging raw sewage pump.—*Buffalo Pumps, Inc., Buffalo 5, N. Y.*

Industrial Exhausters—(32-p. bulletin) Describes new heavy-duty steel plate fan with completely welded housing, adjustable and reversible. Removable front and back plates are interchangeable and large enough in diameter so that the rotor can be removed through the side of fan. Three rotors are available, one for air-handling, two for material. Ratings for all models are published in full.—*Buffalo Forge Co., Buffalo 5, N. Y.*

High-Strength Steel—(68-p. booklet) Contains complete data on properties, fabrication, and application of U. S. Cor-Ten. First section discusses various properties of this high tensile strength steel.

In second section full data are given regarding fabrication by standard practices, including five pages on welding. Test data, lists of equipment and users, together with photographs and charts, are liberally used.—*United States Steel Corp. Subsidiaries, 429 Fourth Ave., Pittsburgh 19, Pa.*



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. . . see why LE ROI AIRMASTERS save time and money

We are proud of AIRMASTER performance. We know what these compressors can do. We want you to know, too. That is why every AIRMASTER has an accurate electric hour-meter.

With this clock, you can easily check the hours of operation against fuel consumption and maintenance costs. You can quickly see the "money-in-your-pocket" benefits produced by the following features that have been so expertly teamed together by Le Roi engineers:

The fuel-saving regulation of the Econotrol.
The efficiency of the cushioned, magnafluxed AIRMASTER valves.
The dry, oil-free air from the new AIRMASTER intercooler.
The life-prolonging, positive lubrication system.
Unit construction — and many other refinements.

Besides showing that AIRMASTERS turn out air at lower cost, the clock keeps track of compressor operating time. This proves dependability, for you find that AIRMASTERS run longer with less trouble.

AIRMASTERS are available in all styles of mountings, and with gasoline or diesel power. Sizes range from 60 to 500 cfm. See your Le Roi distributor for all the facts or write for bulletins. Remember — AIRMASTER* stands for Portable Air Power at is Best.

*Reg. U. S. Pat. Off.

Le Roi Heavy-duty engine

Le Roi 105 Tractair

Le Roi Engine-generator set

Le Roi Centaur Mower

LE ROI COMPANY
MILWAUKEE 4, WISCONSIN
New York • Washington • Birmingham • Tulsa • San Francisco

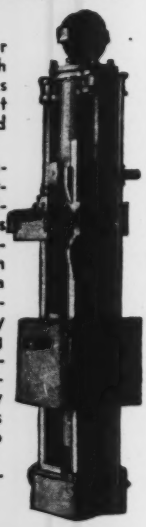
LE ROI MILWAUKEE

C-100

WARRINGTON-VULCAN

Single-Acting Steam

PILE HAMMERS



● This rugged pile driver doesn't monkey with the tough ones. It socks 'em and sinks 'em with scientific power that saves strain on the pile and the pile hammer.

The rapid, regular, continuous action of the Single-Acting Warrington-Vulcan is readily adapted to driving all types of piles—wood, steel or concrete. It operates at medium steam pressure and delivers a moderate frequency of low velocity blows from a relatively heavy ram. Money-saving performance, sturdy construction and simple design exposing all working parts for easy accessibility have made this pile driver a favorite on the tough jobs since 1887.

Full details, without obligation. Write today.

VULCAN IRON WORKS
Since 1852
331 North Bell Avenue
Chicago 12 ---Illinois

Manufacturers' Activities

METALWELD, INC., Philadelphia, Pa., announce that they have been appointed exclusive distributors in the eastern Pennsylvania, south Jersey and Delaware area for the entire Worthington-Ransome "Blue Brute" line. This equipment includes concrete pavers, truck mixers and agitators, portable mixers, pneumatic placing equipment, grout injectors and concrete guns. S. John Oechsle heads the Metalweld organization; John Norris Childs is vice president, and M. L. McIntire is sales manager of the construction equipment division.

HERBERT W. WEHE, president of Overly Manufacturing Co., Greensburg, Pa., has announced the acquisition of McAleenan Brothers Co., Pittsburgh, through purchase. George R. McAleenan will continue as president of the company, according to Mr. Wehe, and all personnel is being retained. The McAleenan plant, established in 1911, produces boilers, tanks, stacks and heavy plate work for industrial plants, railroad, general contracting, etc.

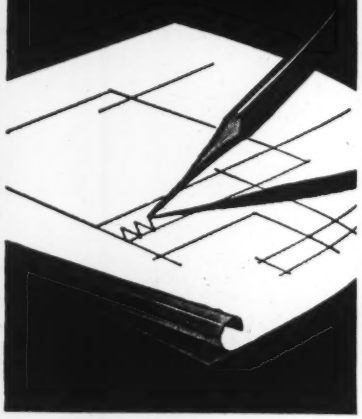
ELMER A. MULSON, for the last ten years sales engineer with the Barney Machinery Co. of Pittsburgh, has been named manager of the Pittsburgh district office of the Baldwin Locomotive Works. Besides diesel and steam locomotives, Mr. Mulson will represent the company in its sales of testing machines, industrial presses, marine propellers, and alloy castings.

G. V. LEECE, vice-president of Gardner-Denver Co., has been appointed general sales manager, located at Quincy, Ill. He joined the company in 1922 where for the past two years he has been vice-president in charge of the export division.

PATTERSON SALES CO., El Paso, Tex., engineering sales representative for machinery and industrial equipment, has been appointed distributor of the Aridifier in Arizona, New Mexico, Mexico and Central America by Logan Engineering Co., Chicago, Ill.

To provide expanded and speedier service to all users of cemented carbide tipped cutting tools in the Allentown-Bethlehem-Easton area in Pennsylvania, CARBOLOY CO., INC., of Detroit, Mich., has appointed the Wm. H. Taylor & Co., Inc., Allentown, Pa., as an authorized distributor; it handles cutting tools, abrasives, general mill supplies,

TRACING CLOTH for HARD PENCILS



● Imperial Pencil Tracing Cloth has the same superbly uniform cloth foundation and transparency as the world famous Imperial Tracing Cloth. But it is distinguished by its special dull drawing surface, on which hard pencils can be used, giving clean, sharp, opaque, non-smudging lines.

Erasures are made easily, without damage. It gives sharp, contrasting prints of the finest lines. It resists the effects of time and wear, and does not become brittle or opaque.

Imperial Pencil Tracing Cloth is right for ink drawings as well.

IMPERIAL PENCIL TRACING CLOTH

SOLD BY LEADING STATIONERY AND DRAWING MATERIAL DEALERS EVERYWHERE

NEW STAINLESS STEEL COMBUSTION CHAMBER INTRODUCED BY DRAVO

PITTSBURGH, PA.: Stainless steel, scientific development which aided the advancement of jet propulsion and turbo-supercharging is now being utilized to provide more efficient and durable combustion chambers in Dravo Counterflo Oil and Gas Fired Heaters. Effective immediately, industrial and commercial heating installations with Dravo Heaters

• **In fabricating the combustion chamber of Dravo Heaters from stainless steel, many extra years of highly efficient operation have been added to the life of a direct fired heater that already has proved its worth in thousands of industrial and commercial installations.**

The most vulnerable part of any heater is its combustion chamber. It is here that scale from high combustion temperatures first causes inefficiency and later failure. Stainless steel has high resistance to oxidation. This revolutionary application of high heat-resisting metal will not only prolong the life of the Dravo Heater, but will aid in maintaining its inherently high efficiency.

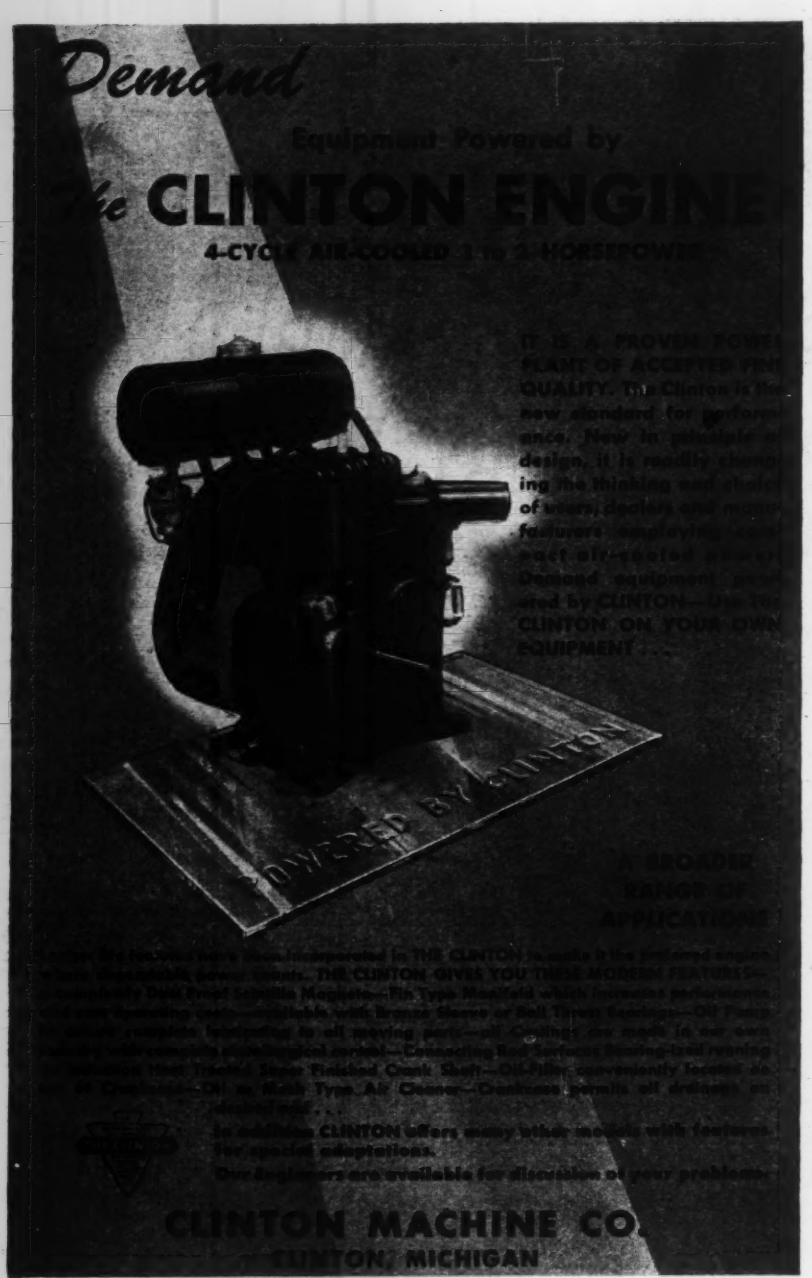
Other advantages gained in this important advancement include: **elimination of refractory with its troublesome maintenance; reduction of overall size and weight of heaters; more flexibility of application and over 100% greater safety factor against burning out when compared with carbon steel.**

These and other improvements make the Dravo Counterflo Oil or Gas Fired Heater the most efficient and durable heater of its type available today. Write for Bulletin AH 516 for details. Dravo Corporation, Heating Section, 300 Penn Avenue, Pittsburgh 22, Pa.

DRAVO

DRAVO CORPORATION

PITTSBURGH • WILMINGTON • PHILADELPHIA • WASHINGTON
NEW YORK • CLEVELAND • DETROIT



AUTOMATIC WATER SAMPLERS
NOW AVAILABLE FOR
PROMPT SHIPMENT
Prices and particulars
gladly furnished upon request.
STUART-BRUMLEY CORP., 516 N. Charles St., Baltimore 1, Md.
STUART – BRUMLEY

pipe, and electrical apparatus. C. S. McElyea, sales manager, will head up the Carboloy operation at Wm. H. Taylor & Co. and C. R. Musselman will act as carbide specialist.

WESTERN MACHINERY CO., announces the appointment of L. T. Maguire as manager of its Salt Lake City branch. He has served as a designing engineer, sales engineer, service engineer and sales and district manager. His experience includes 13 years with the Byers Machinery Co. and 5 years with the Harnischfeger Corp.

JOSEPH T. RYERSON AND SON, INC., steel distributors, have announced the completion of an addition to the structural shop office building at their Chicago plant resulting in added convenience and improved service to customers. The new construction provides 6,500 additional square feet of floor space.

INSLEY MANUFACTURING CORP., Indianapolis, makers of power shovels, cranes and concrete placing equipment, has announced the appointment of the Conners Equipment Co., as distributors for northern Ohio. J. T. Conners, head of the new firm, has spent 25 years in the construction machinery field. For the past 20 years he has been associated with the Thew Shovel Co. of Lorain, O., in various sales capacities.

RUSSELL P. PROFFITT, since 1933 Chicago divisional manager of the Timken Roller Bearing Co., has been transferred to the Washington, D. C. office as district manager. Mr. Proffitt began his career with Timken in 1923 in the Huntington, W Va., office, where he introduced and developed the use of Timken bearings in mining equipment, as an improvement over the plain or cast iron bearings then generally in use. Prior to his joining the Timken organization, he spent several years with the American Car and Foundry Co., in the design of railroad and mine car equipment.

Restricted during war years, escorted plant tours through the Peoria, Ill., factory of CATERPILLAR TRACTOR CO. have been reinstated. During the last complete year in which such trips were permitted, Caterpillar had a total of 19,662 visitors.

BUILDERS IRON FOUNDRY, Providence, R. I., announces the formation of a new affiliate, "Builders-Pacific, Inc.," a California corporation with offices, warehousing and service facilities in San Francisco and Los Angeles. The main office of Builders-Pacific is located at 921 University Ave., Berkeley, and the Los Angeles office at 2085 Belgrave

YOU BUY EXPERIENCE WHEN YOU BUY HENDRIX

HENDRIX *Lightweight* DRAGLINE BUCKETS

Yes, Sir, Hendrix Lightweight Dragline Buckets were designed by a man who has moved dirt and plenty of it. His desire and need for a better bucket has resulted in the best functioning unit available today and for years to come. Its lightness does not detract from its durability. Larger buckets can small operations and still maintain the allowable loaded weight. You'll get BIGGER PAYLOADS on operations requiring a long boom, and in wet digging you leave the water in the pit. We took the load OUT OF THE BUCKET . . . to let you put it INSIDE.

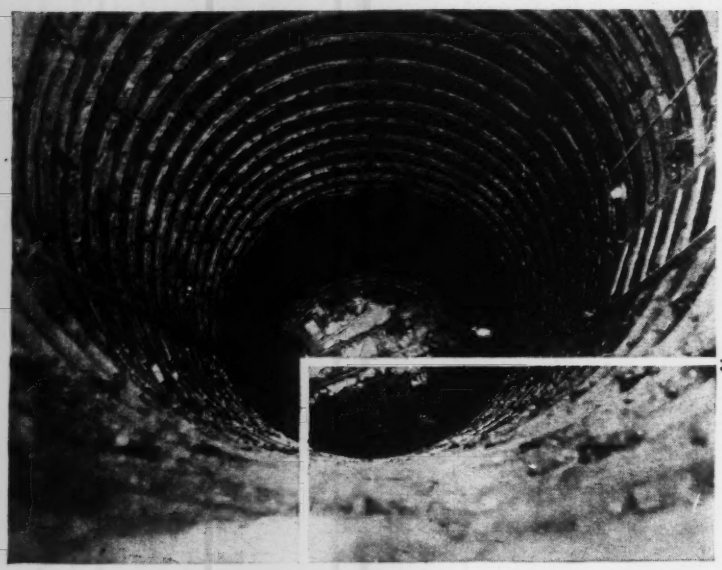
3/8 to 30 Cubic Yards

COMPARE THESE FEATURES

- ★ 20% to 40% lighter than other buckets, type for type.
- ★ All welded construction for greater strength and durability.
- ★ Manganese Steel chains, fittings, and reversible tooth points.
- ★ Full Pay Load every trip, even in wet digging.
- ★ Perfect Balance; handles easier, fills faster, dumps cleaner.
- ★ Three types; light, medium, and heavy duty. With or without perforations.

Write for descriptive literature—or ask your dealer.

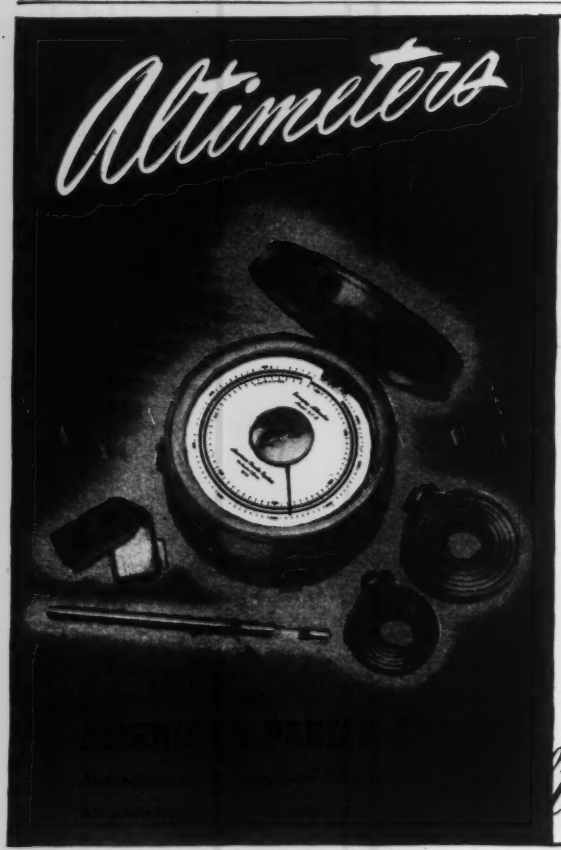
HENDRIX MANUFACTURING COMPANY
MANSFIELD INCORPORATED LOUISIANA



DRIVE TUNNELS FASTER!

Commercial Tunnel Liners & Plates are easy to install — inexperienced help can put them up in a surprisingly short time. Beat the schedule! Read up on Commercial Tunnel Liners and Supports in the Commercial "Tunnel Book". Write for your copy today.

The COMMERCIAL SHEARING & STAMPING CO. Youngstown 1, Ohio



Altimeters

...FOR ALL PRELIMINARY SURVEYS

How much money will this instrument save YOU? Preliminary surveys in 1/10th the time with accuracy better than 1 part in 1000.

Model SA-1: Range: 4,360 ft. (−760' to +3,600') in intervals of 2'

Model SA-2: Range: 10,600 ft. (−900' to +9,700') in intervals of 5'

Model SA-5: Range: 15,000 ft. (−500' to +14,500') in intervals of 10'

All models priced $200 complete with case, hand and shoulder straps, magnifier and thermometer. IMMEDIATE DELIVERY—see your dealer or write direct for descriptive folder.

Altimeters

Ave., Huntington Park. Builders-Pacific will represent Builders-Providence, Inc., the Omega Machine Co., formerly of Kansas City, Mo., and, in Northern California, Proportioneers, Inc.; it will also represent the Walker Process Equipment Inc., of Aurora, Ill.

APPOINTMENT OF K. P. SWANSON, 204 Chapel St., Abington, Mass., to represent Progressive Welder Co., in eastern Connecticut, eastern Massachusetts, Rhode Island, Maine, Vermont and New Hampshire, has been announced.

ROY A. SHIPLEY, president of the National Fireproofing Corp., Pittsburgh, Pa., was elected president of the Structural Clay Products Institute at a recent convention. Mr. Shipley, a member of the organization's board of directors for three years, has served as chairman of the association's research committee and also is a member of the American Ceramic Society.

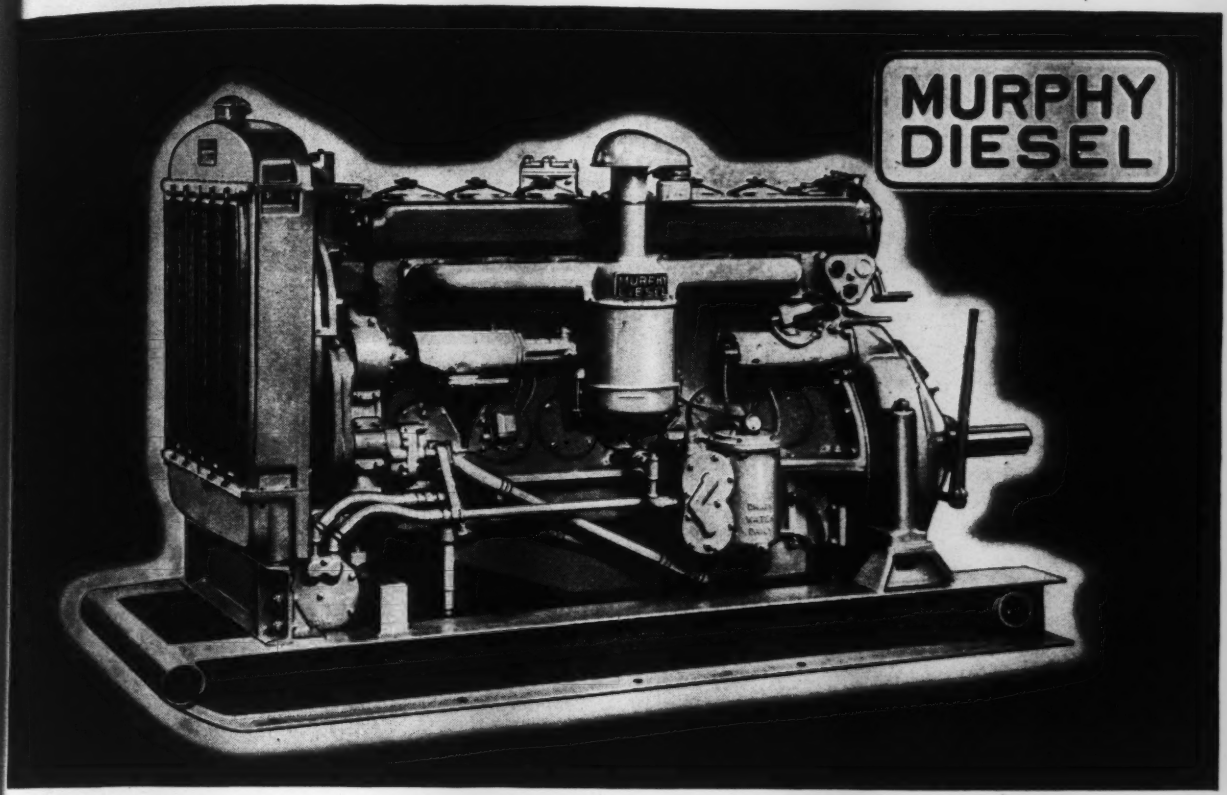
Other officers elected at the convention were: vice president, Joseph A. Brown, president of the Baltimore Brick Co., Baltimore, treasurer, W. Gardner Long, treasurer of the New England Brick Co., Boston; and secretary, J. J. Cermak of Washington, D. C.

A MOTION PICTURE about cotton canvas for use in industry and commerce, depicting especially the modern methods of treatment to provide protection against fire, water, weather and mildew, presented by Philadelphia Textile Finishers, Inc., Norristown, Pa., is available without charge through William L. Barrell Co., Inc., (selling agents) New York, N. Y.

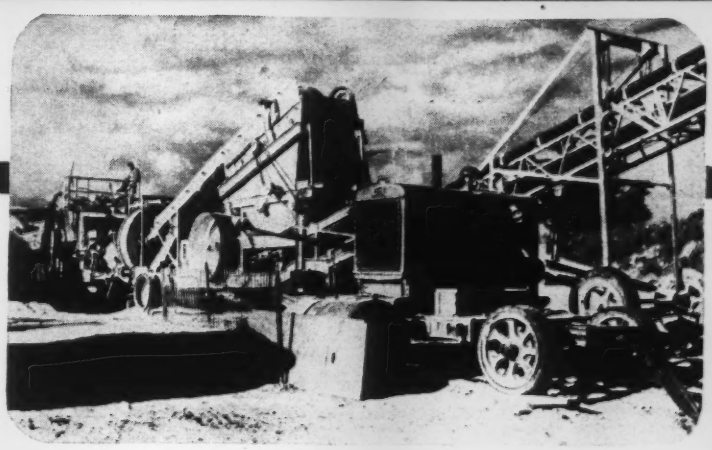
CLINTON E. STRYKER, president of Adel Precision Products Corp., Burbank, Calif., announces the appointment of Ed. J. Towey, Minneapolis, Minn., as sales manager, Industrial Division. Mr. Towey was formerly executive vice-president in charge of sales, engineering, advertising and development of new products for the Diamond Iron Works of Minneapolis.

THE B. C. AMES CO., Waltham 54, Mass., has recently been reorganized with Warren Ames as president and H. G. Haynes as treasurer. This 47-year-old concern will continue the manufacture and merchandising of micrometer dial gauges and micrometer dial indicators.

THOMAS A. DEMARCO, formerly with United Aircraft Products Corporation, has been named executive assistant to John J. Bergen, chairman of the board of Gar Wood Industries, Inc., with headquarters in New York, it is announced. Mr. De Marco previously was with the Chapman Valve Manufacturing Co.,



MURPHY DIESEL Model ME-6, 6-cyl., 5¾x6½", full Diesel engine, 135 HP continuous, 160 HP intermittent, powering a Universal Portable Jaw Crusher, (24 x 36"), owned by Art Overgaard, Elroy, Wis.



Profitable Power for Your Plant

When it comes to "making rock", MURPHY DIESEL performance is outstanding. The advantages of these rugged, dependable engines add up simply to this: You get more output, at low cost, with better profit per job. MURPHY DIESELS respond instantly to the heavy surge-loads, and have the stamina to stay with the long, steady load-pulls. Wherever dependable, economical heavy-duty power is needed, MURPHY DIESELS are "ready to go". Write for bulletin.

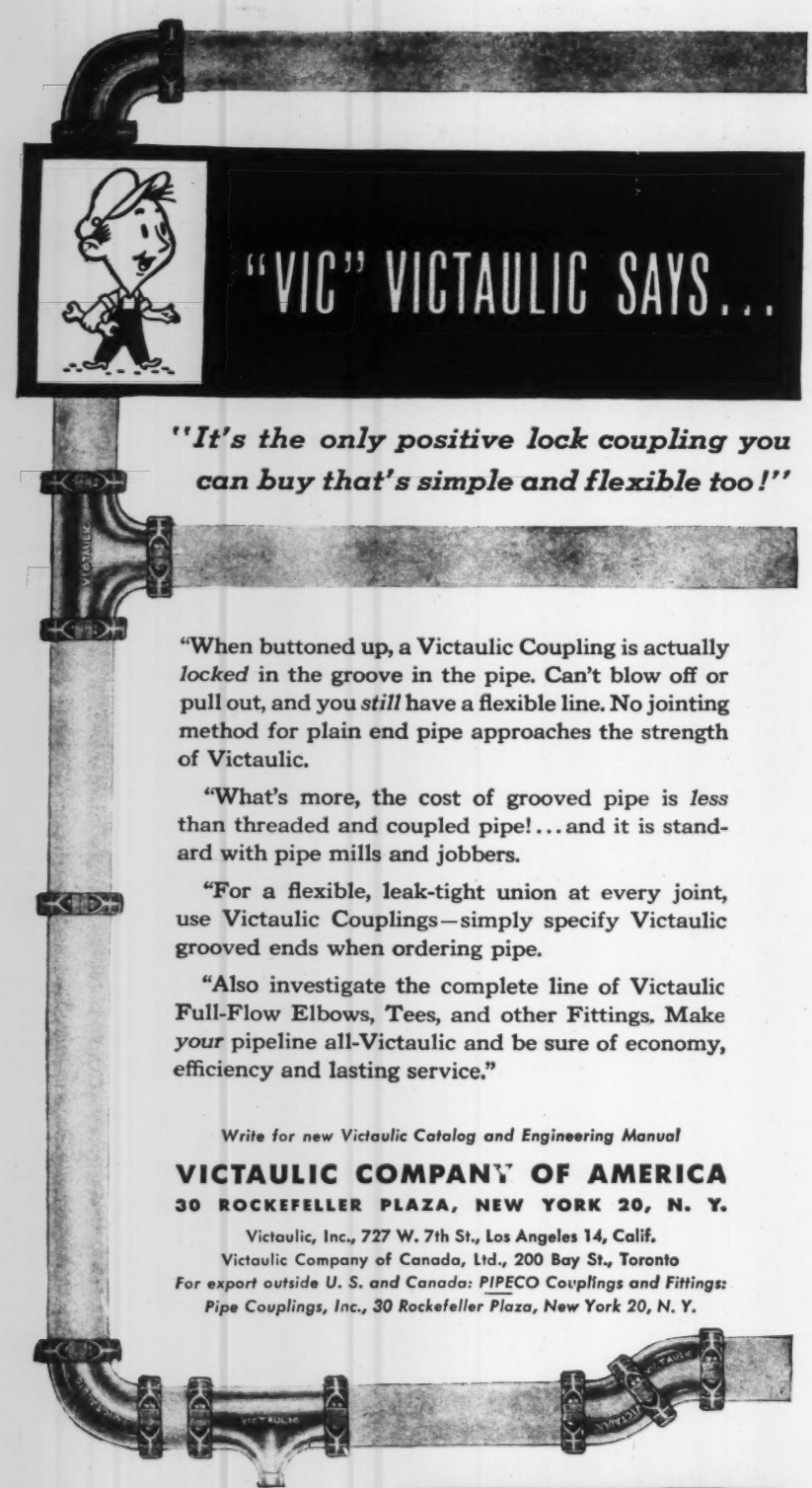
MURPHY DIESEL COMPANY
5311 W. Burnham Street • Milwaukee 14, Wisconsin

DIESEL ENGINES: 90 HP TO 215 HP

MURPHY DIESEL

GENERATOR SETS: 60 KW TO 115 KW

Dependable Heavy-Duty Power


"VIC" VICTAULIC SAYS...
"It's the only positive lock coupling you can buy that's simple and flexible too!"
"When buttoned up, a Victaulic Coupling is actually *locked* in the groove in the pipe. Can't blow off or pull out, and you *still* have a flexible line. No jointing method for plain end pipe approaches the strength of Victaulic.
"What's more, the cost of grooved pipe is *less* than threaded and coupled pipe!... and it is standard with pipe mills and jobbers.
"For a flexible, leak-tight union at every joint, use Victaulic Couplings—simply specify Victaulic grooved ends when ordering pipe.
"Also investigate the complete line of Victaulic Full-Flow Elbows, Tees, and other Fittings. Make *your* pipeline all-Victaulic and be sure of economy, efficiency and lasting service."
Write for new Victaulic Catalog and Engineering Manual
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Victaulic, Inc., 727 W. 7th St., Los Angeles 14, Calif.
Victaulic Company of Canada, Ltd., 200 Bay St., Toronto
For export outside U. S. and Canada: PIPECO Couplings and Fittings: Pipe Couplings, Inc., 30 Rockefeller Plaza, New York 20, N. Y.
Have you considered Victaulic for your piping requirements?
Sizes—¾" through 60"
SELF-ALIGNING PIPE COUPLINGS
VICTAULIC
EFFICIENT FULL-FLOW FITTINGS
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Springfield, Mass., and then with the Johns-Manville Sales Corp.

JAMES D. GREENSWARD has been named assistant to William C. Johnson, vice-president of the general machinery division of the Allis-Chalmers Mfg. Co., Milwaukee, Wis. Mr. Greensward has been associated with Allis-Chalmers since 1922. Also, Ned Landis has been named branch manager of the Syracuse, N. Y. office of the Allis-Chalmers Mfg. Co., Milwaukee, Wis. Mr. Landis has been with their Cincinnati office.

GEORGE A. HAYS has been appointed vice president and general manager of the Hinderliter Tool Co., a division of H. K. Porter Co., Inc., at Tulsa, Okla., following the retirement of Frank J. Hinderliter who founded the company in 1920. The company manufactures oil field drilling equipment.

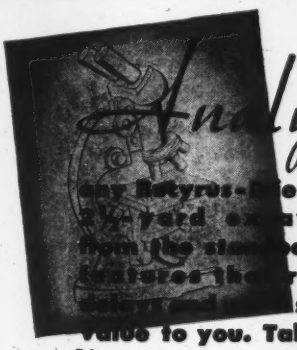
THE PITTSBURGH PLATE GLASS CO. has announced the purchase of the Morck Brush Manufacturing Co. of San Francisco, according to J. H. Heroy, vice president of the glass firm. A manufacturer of painters' brushes and master painters' tools, the San Francisco unit will continue operation as the Morck Brush division of the Pittsburgh Plate Glass Co.

JOHN E. ANDERSON has been appointed manager of the new Indianapolis sales and service office of the Wheelco Instruments Co., Chicago, Ill., at 107 S. Capitol Ave., Indianapolis 4, Ind. Mr. Anderson will be assisted by Walter A. Jones, service engineer, at Indianapolis and by L. A. Wallingform, district manager, Cincinnati.

FOUR EXECUTIVES of The Permutit Co. have recently been elected vice-presidents, the company's New York City office announced recently. They are: J. D. Yoder, who has been manager of the boiler feedwater division: D. J. Saunders, manager of industrial sales; G. N. Proctor, manager of manufacturing, and H. L. Bechner, who has held the post of technical manager.

JOSEPH T. RYERSON AND SON, INC., Chicago steel distributors, has announced appointment of Freeman X. Kinzie as west coast representative of the bearings and babbitt division. He will specialize in the sale of non-metallic bearings and babbitt metals, making his headquarters at Los Angeles.

THE APPOINTMENT of John C. Campbell as manager of industrial engine sales, and James W. Brown as advertising manager was announced recently by V. C. Genn, general sales manager for the Detroit Diesel Engine Division of General Motors.



Analyze any Bucyrus-Erie ⅜- to 2½-yard excavator from the standpoint of features that reduce [illegible] see its value to you. Take the ½-yard 15-B for instance:

MOBILITY: The 15-B is easy to steer in sharp or gradual turns and there's plenty of power to climb grades up to 30%. Time spent in moving is cut to a minimum.

MATERIALS: Only controlled-quality materials, properly treated, are used.

WEIGHT: The lightest weight consistent with ample strength is maintained throughout so that stresses on all parts of the machine are kept at a minimum. The 15-B, like all other Bucyrus-Eries, is individually designed for its work.

PERFORMANCE: The smooth, quiet performance of the 15-B—obtained with widespread use of anti-friction bearings, oil enclosed gears and accurate alignment—means less maintenance, reduces operator fatigue, and increases digging time.

ADJUSTMENTS: All adjustments, including singlepoint adjustments on clutches and brakes are easily made and stay put for long periods.

ACCESSIBILITY: Parts are large, simple, few in number, easy to get at for replacing. Lubrication fittings are easy to reach, hard to miss.

CONTROL: All operating levers, including lever for positive digging lock, are grouped at the operator's position. There are no time-wasting delays caused by the operator's having to leave his normal position.

CYCLE: All functions are balanced and synchronized so that there is no overstressing of any part or parts to cause too-frequent adjustments and excessive wear.

64E46

you make the most of EVERY HOUR with a BUCYRUS-ERIE

[illegible] COMPANY • SOUTH [illegible] WISCONSIN

Buildings, equipment, machinery . . . in all of them galvanizing (zinc-coating) against rust is good engineering, sound economy.

Zinc, in the form of galvanizing, protects against rust in TWO WAYS: *First,* by simple coverage, with a sheath of rust-resistant metal . . . *Second,* by electro-chemical action, or "sacrificial corrosion." Good design that includes zinc-protected steel or iron means long-time, low-cost protection . . . savings in materials and maintenance. It's wise to specify heavy coatings—for the heavier the coating, the better the protection. The "Seal of Quality," shown at the right, is the yardstick of economy and service-life in galvanized sheets. It denotes at least 2 oz. of Zinc per square foot!

ZINC INSTITUTE 2 OZ. COATING SEAL OF QUALITY

American Zinc Institute

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Send this COUPON for valuable FREE BOOKLETS

These factual, illustrated booklets are yours for the asking. They tell how ZINC can solve modern day rust problems. Check your needs and mail today.

- ☐ Facts About Galvanized Sheets
- ☐ Use Metallic Zinc Paint to Protect Metal Surfaces
- ☐ Repair Manual—Galvanized Roofing and Siding
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The **PHOENIX BRIDGE CO.**

BRIDGES and BUILDINGS

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District Offices

New York, N. Y. Boston, Mass.

Washington, D. C.

DRILLING CONTRACTORS

DIAMOND AND SHOT CORE BORINGS — DRY SAMPLE BORINGS

Foundation Testing for Bridges, Dams and All Heavy Structures

Also

Manufacturers of Diamond and Shot Core Drills, Accessories and Equipment

SPRAGUE & HENWOOD, Inc.

Scranton, Pa. Dept. E, U. S. A.

Men and Jobs

Col. Harry D. Williar, Jr., Army Engineer of two wars and former chief engineer of the Maryland State Roads Commission, has entered into a consulting engineer partnership with Van Rensselaer P. Saxe and Robert E. Robertson, Jr. The new firm, Saxe, Williar and Robertson, at 130 W. Hamilton Street, Baltimore, Md., will engage in highway and regional planning and the design of bridges, port facilities and other structures.

At present Colonel Williar is acting as a consultant to Baltimore on its proposed expressway.

Colonel Williar, after being graduated from the University of Maryland with a degree in engineering, went to work for the State Roads Commission in 1907. In 1912 he became assistant engineer with the paving commission of Baltimore. From 1917 to 1920, he served with the American Expeditionary Forces in France and in the occupation of Germany. He returned to the State Roads Commission in 1920 and in 1928 became chief engineer until 1935. In the second World War, he was staff engineer with the Army Air Forces at Richmond, Va., Airbase, Bolling Field and Langley Field.

Mr. Saxe has been in private practice in Baltimore since 1920. Major Robertson, recently with the U. S. Corps of Engineers, was formerly design engineer with Mr. Saxe.

Phil C. Royer, superintendent for the Amis Construction Co., will be general superintendent in charge of construction of the Potholes Dam on the Columbia Basin project, contract for which is held by Amis with the C. F. Lytle Construction Co. and the Green Construction Co.

Willis C. Christopher has been transferred from the Boise, Ida., office of the Bureau of Reclamation to Ephrata, Wash., as assistant supervising engineer, irrigation division, Columbia Basin project. He had been chief of the bureau's branch of design and construction, Region 1, at Boise since September, 1944. He joined the bureau in 1914 as a canal rider on the Flathead project in Montana, after receiving his degree in civil

WHY IS RIGHT-ANGLE LOADING BETTER?

It assures longer bearing life . . .

Permits heavier radial and thrust loads . . .

Reduces load on each individual roller . . .

Cuts down service attention . . .

ROLLWAY Right-Angle-Loaded BEARINGS have *every one* of these advantages because they reduce every load to its component parts—*pure radial and pure thrust* . . . and carry *each* of these loads on a *separate* bearing assembly—AT A RIGHT ANGLE TO THE ROLLER.

Because of this, Rollway Bearings can use solid cylindrical rollers of greater mass and cross-section area in a given space. Result: *increased load capacity . . . reduced maintenance attention . . . longer wear, with no pinching or wedging, less friction on roller ends.*

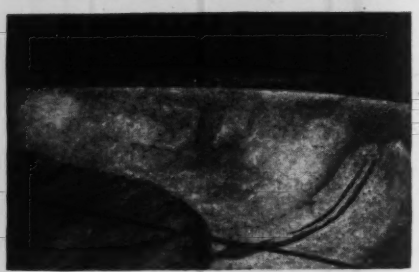
Send us your plans today for engineering analysis and bearing recommendations.

ROLLWAY BEARING CO., INC.
Syracuse, N. Y.

SALES OFFICES:
Philadelphia, Boston, Pittsburgh, Youngstown, Cleveland, Detroit, Chicago, St. Paul, Houston, Los Angeles

Rollway CYLINDRICAL ROLLER BEARINGS

CEMENT GUN COMPANY
"GUNITE" CONTRACTORS
GENERAL OFFICES—ALLENTOWN, PENNA., U.S.A.



DAM REPAIRED WITH "GUNITE"

The two photographs show the Bulls Bridge Dam of the Connecticut Light and Power Company, which is one of many dams we have repaired for this Company.

The upper view shows the work in progress, and gives some idea of the condition of this structure before repairs were made. The lower view is of the completed job.

After chipping out the loose and disintegrated concrete and sandblasting the entire area, heavy reinforcing mesh was placed over the surface of the old concrete and "GUNITE" applied two inches thick, plus the material required for filling deply eroded portions.

Our 72-page bulletin A2300 describes scores of similar "GUNITE" jobs.

Write today for bulletin A2300.

MANUFACTURERS OF THE "CEMENT GUN"

SAUERMAN CABLEWAY SYSTEMS
Dig, Lift, Haul and Dump with One-Man Control

Pictured above is a light SAUERMAN Tautline Cableway, pouring concrete for reservoir. It also made the excavation, being first rigged as a SAUERman Slackline Cableway, then converted into tautline conveyor.

On thousands of jobs all over the world SAUERMAN Machines are digging, lifting and hauling materials for considerable distances in one operation —making tough jobs easy and cutting costs wherever installed. One operator does the job! Speedy and powerful with long, adjustable range. Low initial cost. Small power consumption and easy, inexpensive maintenance.

Write for complete illustrated catalog.

SAUERMAN BROS., INC.

532 S. Clinton St. Chicago 7, Ill.

engineering from the University of Washington. After working up to office engineer at American Falls Dam, Ida., in 1926, he left the bureau to become assistant engineer for an American contracting firm developing irrigation projects for the Mexican government, and from 1929 to 1938 he was designing engineer for the Metropolitan Water District of Southern California.

Otto F. Goeke, district 2 engineer, Illinois Division of Highways, Dixon, is retiring. After being graduated from the University of Wisconsin in civil engineering, Goeke served in the bridge design department of the Great Northern Railroad; then in the bridge department of the Chicago, Milwaukee, Saint Paul, and Pacific Railroad; and later, for one and a half years with the American Bridge Co. In 1914 he started with the Illinois Division of Highways as junior highway engineer. From 1917 to 1922 he served as assistant district engineer, being promoted to district engineer in Dixon in 1922.

Last year Mr. Goeke, received an award of merit from the American Association of State Highway Officials given those who had served 25 years or more with distinction. He has had an enviable record of 32 years of continuous service with the Illinois Division of Highways.

Maj. Guy Beaudet, civil engineer, has been appointed to the post of assistant port manager of the harbor of Montreal, Que.

Donald L. Renick, now employed in the construction department of Swift & Co., Chicago, was separated from the Air Corps Nov. 12 last after having served three years as post engineer in central New York. He was assistant post engineer at Rome, N. Y., Army air field. In December, 1945 he was transferred to the Syracuse, N. Y., Army air base as post engineer and later officer in charge. Last April he was transferred to the N. Y. State fair grounds used as a supply depot during the war. That entire installation was closed out, the property having had an original purchase value estimated to be over $100,000,000.

Donald E. Whelan transferred recently from the U. S. Engineer Office, Jacksonville, Fla., to the Northeastern Forest Experiment Station of the U. S. Forest Service in Philadelphia, Pa., as

The Pump
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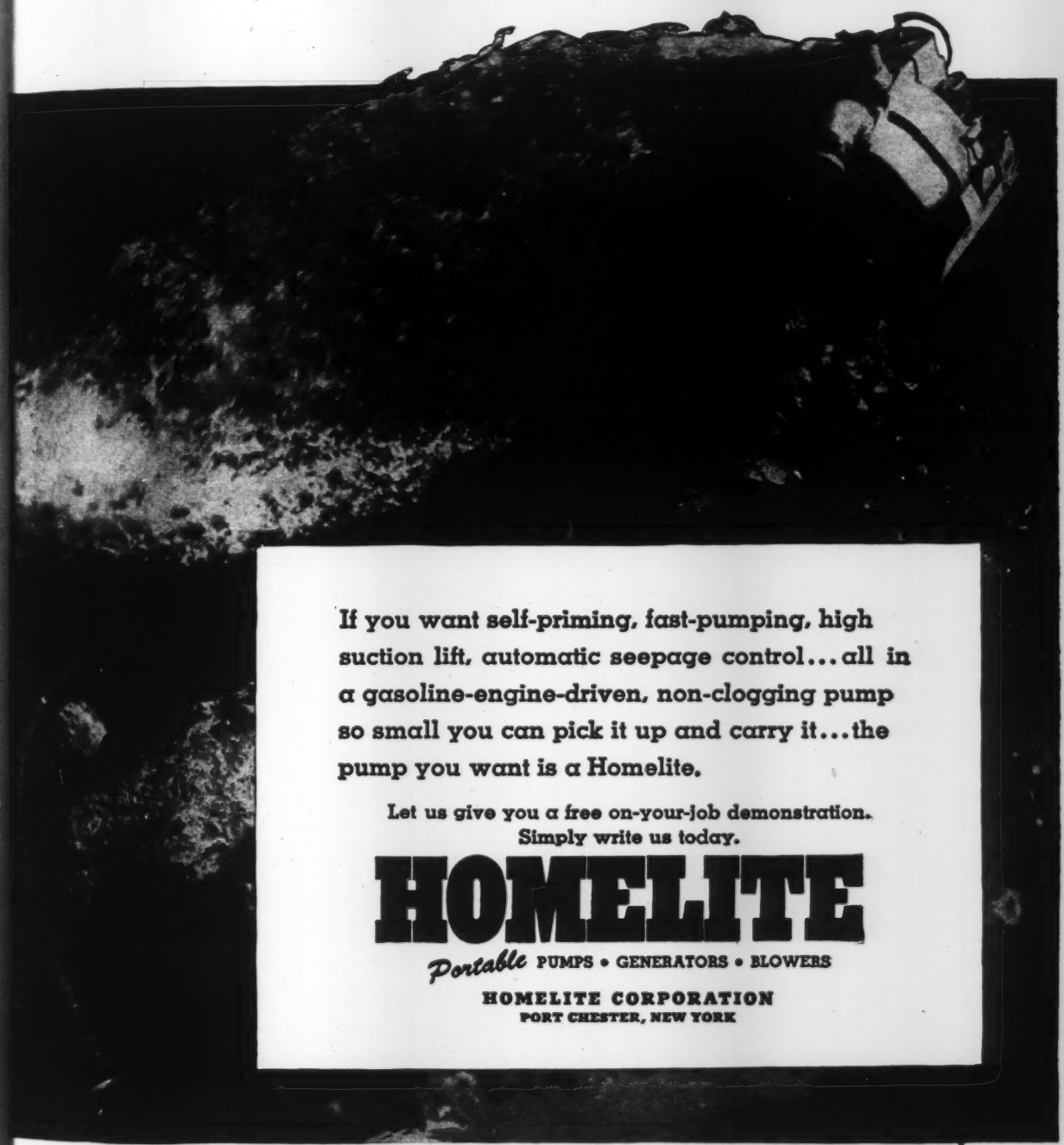

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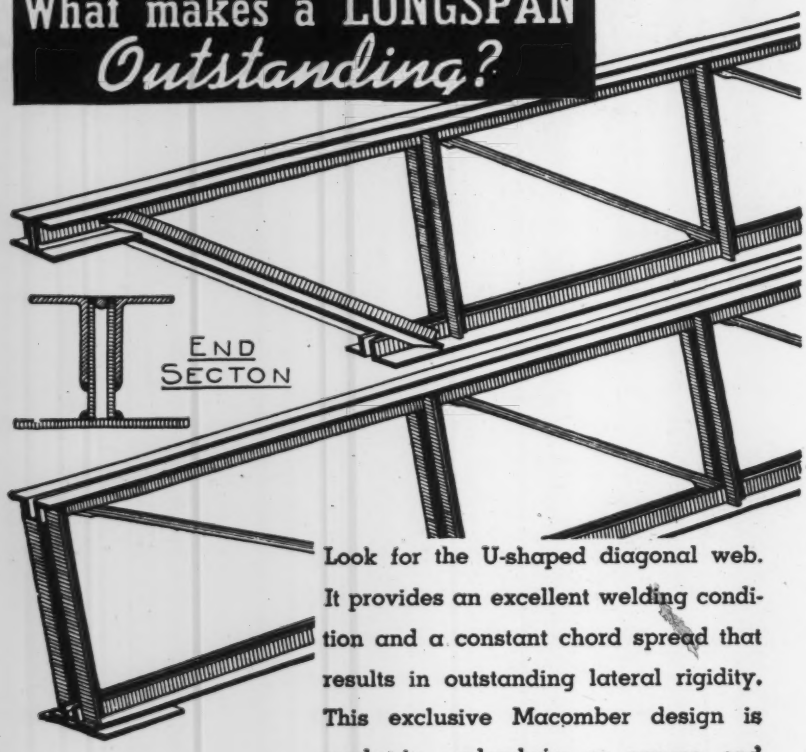

Look for the U-shaped diagonal web. It provides an excellent welding condition and a constant chord spread that results in outstanding lateral rigidity. This exclusive Macomber design is made in underslung or square end types with sloping or parallel chords in lengths up to 70 feet. Here is a completely standardized structural unit, specified from load and span tables for unobstructed floor or roof support. Get our complete design information for your next project.

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hydrologist to work on flood control reports. **Mr. Whelan,** graduate civil engineer, Rensselaer Polytechnic Institute, 1931, was associated for 5 years with the Metropolitan Water Bureau of Hartford, Conn., on the design and construction of Saville Dam. He has been with the U. S. Engineers for the last ten years actively engaged on flood control hydrology at Providence, R. I., Rock Island, Ill., Buffalo, N. Y., and Jacksonville, Fla.

Charles Alfred Paquette, 74, died recently at Sturgis, Mich. A graduate of Notre Dame in 1891, most of his engineering career was in railroad work. In 1924 he resigned as chief engineer of the Big Four Railroad to become president of the White Construction Co., contractors, Chicago. At the time of his death Mr. Paquette was president of the Paquette Engineering Corporation.

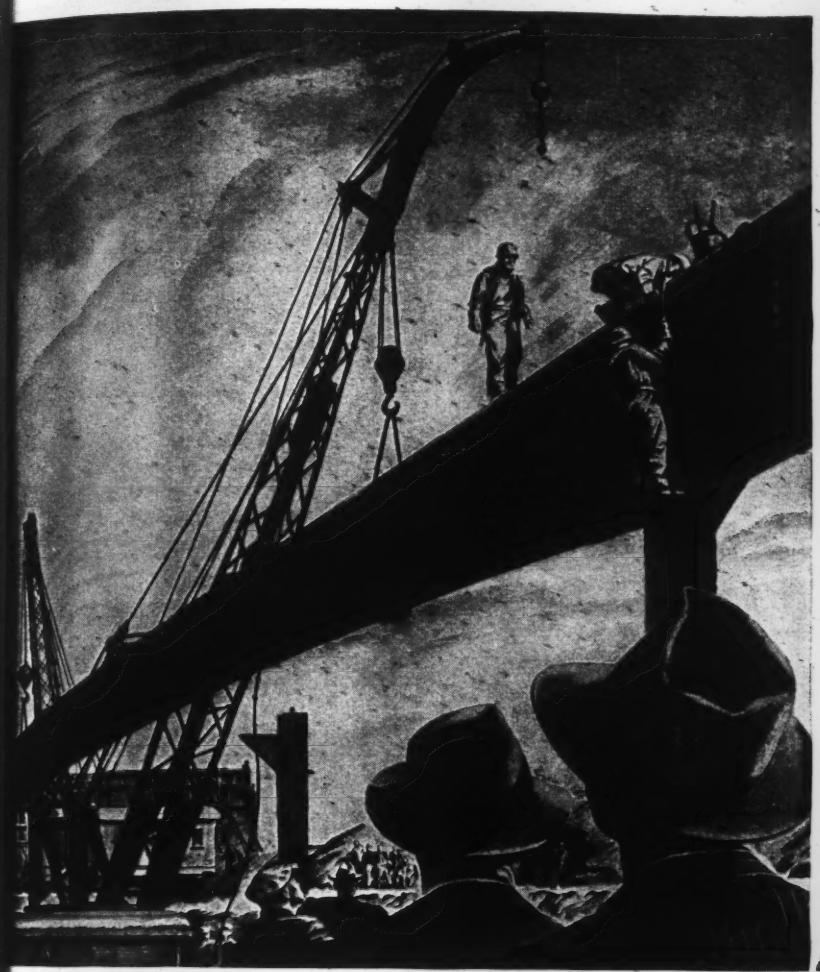
Archer F. Breed, 68, civil engineer, died recently in California. He was graduated from the University of Maine. He also received an engineering degree from the University of Charlottenberg, Germany.

Lieut. Col. Harold B. Stuart, 57, veteran of both world wars, and former district engineer officer for Military District No. 2 of the Canadian Army, died at Ottawa Oct. 14. A graduate in civil engineering of the University of Toronto, Colonel Stuart was for many years connected with the Hamilton Bridge Co., Ltd., at Hamilton, Ont.

Vernon Weaver, Albert Schaff, and **Reavis Drake,** engineers, have recently started work with Casler and Stapleton, consulting engineers, Jacksonville, Ill. Weaver from 1931 to 1940 served as assistant city engineer, while Mr. Stapleton was city engineer, in Jacksonville, Ill. During the war he was with the Army Engineers, most recently in Japan. Schaff served with the Engineer Corps, sanitary sewer and sewer treatment division. Drake served during the war with the Engineer Corps in India and Burma. Before that time, he was assistant county superintendent of highways, Pike County, Ill. Weaver and Schaff will serve as designing engineers, Drake as field engineer.

M. B. Doyle, Bloomington, Ind., city engineer, has resigned to accept a federal engineering appointment.

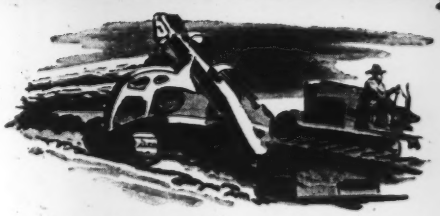
Harry Smith has been appointed Knox County superintendent of highways at Galesburg, Ill. For the past 18 months since the death of Otto Goerick he has been filling this post in a temporary capacity.



If you're a "Sidewalk Superintendent"

-watch the wire rope

Here's a show that scores a hit wherever it plays—building erection. These big cranes pick up steel girders and mesh them into place like the gears in your car. The star in the cab does it with levers and Preformed wire rope.



Logging machinery moves dead-weight logs with wire rope providing the sinews. Preformed wire rope gets top billing because it handles easier, resists kinking and stands the gaff.

Earth moving has come a long way since the day of the pick, shovel and wheelbarrow. Now bulldozers, shovels and trench hoes make the dirt fly—and their moving parts are actuated by wire rope, Preformed preferred.

On jobs like these and hundreds of others the new wire rope —Preformed—is breaking old performance records. Operators like it because it's safer and handles easier. The office likes it because it lasts longer and reduces time lost for replacement. It makes money by saving money.

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Elections and Activities

A. B. Burton, president of the A. B. Burton Co., Lynchburg, Va., was elected president of the Virginia Road Builders' Association at that organization's recent annual meeting in Richmond. He succeeds Wm. A. Penick, who becomes a member of the board of directors.

Other new officers are: G. P. Clay, president of the G. P. Clay Co., Richmond, vice-president, and T. E. Ritter of the T. E. Ritter Co., and W. J. Hardy of the Arlington Asphalt Co., Rosslyn, Va., new members of the board of directors. Henry C. Hofheimer, II, continues as secretary-treasurer of the association.

Retiring directors are: F. McK. Davison and E. V. Williams. Sterry J. Mahaffey, formerly manager of Henrico County, Va., and Durham, N. C., is engineer-director of the association. Before going into city manager work Mahaffey worked eleven years with the Virginia Department of Highways.

L. S. Finch, chief engineer, Indianapolis Water Co., has been elected president of the Indiana section, American Society of Civil Engineers, succeeding R. B. Wiley, Purdue University. Carl E. Vogelsang, chief engineer, State Board of Health, was re-elected secretary.

The Wisconsin Section of the American Water Works Association has elected J. J. McCarthy of Racine, chairman, Verne Somers of Stevens Point, vice-chairman, J. A. Snow of Ashland, director and L. A. Smith of Madison was elected secretary-treasurer.

John T. Howard, planning director of the Cleveland Plan Commission, has been elected president of the Ohio Planning Conference, succeeding Standish Meacham, Cincinnati. Other officers elected were: Charles P. Lauderbaugh, Columbus, chairman of the Franklin County Planning Commission, first vice-president; George D. Lehman, Toledo, of the City Planning Commission, second vice-president; Nicholas F. Nolan, Dayton, president of the Montgomery County Planning Commission, third vice-president. Sherwood D. Reeder, director of Cincinnati Master Planning, was renamed secretary-treasurer. Elected to the board of directors were: George C. Gigson, Xenia; Frank Sohn, Toledo; W. W. Cotton, Dayton; Robert E. Bordner, Peninsula; H. B. Boehm,

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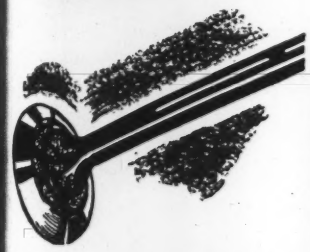
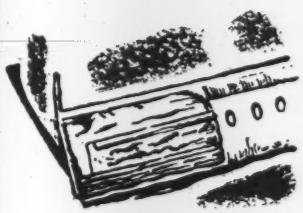
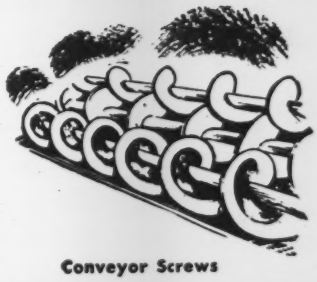
FROM EXHAUST VALVES TO DRILLING BITS . . .



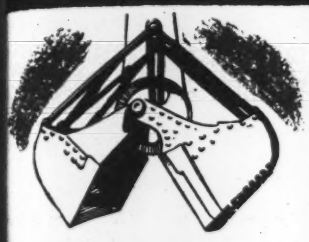
Exhaust Valves



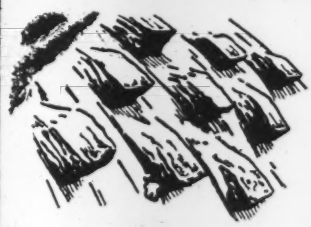
Bulldozer Tips



Conveyor Screws

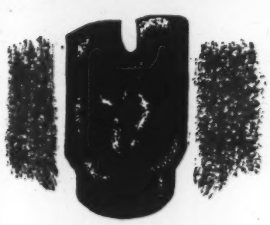


Clam Shells



Roll Crusher Teeth

Track Rollers



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Whatever your problem — heat, corrosion, impact or abrasion — Stoody hard-facing alloys will give you the most effective solution. With one application of these wear-retarding materials the service life of both new and worn parts is increased many times. Listed below are some of the most widely used Stoody alloys.

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1—STOODITE. A cast alloy rod recommended for application where wear resistance is particularly important. Deposit tends to polish under abrasion. Applied electrically or by gas process. Deposits test from 54 to 58 on Rockwell "C" scale.

2—STOODY SELF-HARDENING RODS. A rod fabricated of steel strip and carefully selected alloys. Suitable for electric or gas application. Good wear resistance and high impact strength in relation to hardness. Forms excellent bond with manganese steel. Particularly useful for hard facing excavating equipment. Can be forged without loss of hardness. Deposits test from 52 to 54 on Rockwell "C" scale.

3—STOODY No. 1. A non-ferrous, hard-facing alloy consisting of cobalt, chromium and tungsten . . . excellent corrosion resistance . . . retains hardness and wear resistance even at red heat . . . cold hardness of 53 to 55 on Rockwell "C" scale. May be used wherever heat, abrasion and corrosion are involved. While recommended for application by gas process, rods suitable for electric application are available. Rockwell "C" hardness A.C., D.C.: 46 to 50.

4—STOODY No. 6. Excellent corrosion resistance . . . high impact and good wear resistance with some degree of ductility . . . retains hardness and wear resistance at red heat . . . cold hardness of 42 to 44 Rockwell "C" Scale. May be used wherever heat, impact, abrasion and corrosion are involved. While recommended for application by gas process, rods suitable for A.C. or D.C. electric application are available.

5—TUBE BORIUM. A fabricated rod composed of particles of Borium and mild steel strip . . . forms an extremely hard surface, which is heterogeneous and will resist wear better than any other metal. Because of the great, almost diamond-like hardness of the Borium particles, this rod has highly efficient cutting qualities on the edges of rotary drilling bits, bean knives and the like . . . as well as being resistant to abrasion on scarifier teeth, grader blades and similar tools.

There are two types of Tube Borium, Acetylene Tube Borium, for oxyacetylene application only, and Electric Tube Borium for electric application only.

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CONCRETE EVIDENCE That a **STOW** *Concrete Vibrator will save you . . .*

TIME Very dry concrete, carrying a minimum of "water of lubrication" which "sets-up" quickly can be successfully placed in the forms. Result: forms can be "stripped" sooner, the work greatly stepped-up.

MONEY By using vibration, more aggregate can be used, less mortar required, to make a tight, dense concrete. When you save mortar you save cement, the most expensive ingredient in the mixture.

LABOR With a STOW Vibrator, one man can place as much concrete in the forms as four or five men using hand methods of puddling or spading.

For up-to-the-minute information on the latest developments in concrete vibrating equipment write for this free pamphlet . . .

STOW Manufacturing Co., 19 Shear St., Binghamton, N. Y.

Washington Court House; Myron D. Downs and Standish Meacham, both of Cincinnati.

The Spokane Construction Council has named J. L. Hazen, Les N. Johnson and Lars Carlson to 2-year terms and Al Larson, R. L. Northrop, Gordon Reed, Bert Lyall and Robert Anderson to 1-year terms on the board of directors.

Montana Civil Engineers have elected John W. Hall, consulting engineer of Fort Shaw, as chairman.

Clifford Fore, superintendent of the water and sewage plants, Carbondale, Ill., has been elected chairman of the Illinois Sewage Treatment Works Operators. Other officers elected were L. W. Hunt, Galesburg, Ill., vice-chairman; and David Miller, Springfield, Ill., secretary.

The Texas Association of Home Builders, a new organization, has elected the following officers at Houston: Fred Buchek, San Antonio, president; Roy Hayes, Port Arthur, and Dick Hughes, Pampa, district vice-presidents; Aliene Salmon, Amarillo, treasurer.

Garner W. Miller, executive assistant to the district engineer, Memphis Engineer District has been named president of the Mid-South Section, American Society of Civil Engineers, succeeding George R. Schneider, of Little Rock, Ark. John Strom, Little Rock, was elected vice-president; Henry W. Dougherty, Memphis, secretary-treasurer. New directors named for 1947 are S. K. Jackson, Fort Smith, Ark.; and Raymond W. Sauer, Vicksburg, Miss.

E. J. Maupin has been elected permanent chairman of the Western Chapters conference of the Associated General Contractors of America. Other officers chosen were A. L. Atherton, Seattle, Wash., and H. L. Royden, Phoenix, Ariz., vice-chairmen.

William W. Moore, member of the engineering firm of Dames and Moore, has been elected president of the Structural Engineers Association of Northern California, and John A. Blume, consulting structural engineer of San Francisco, vice-president. The new director is R. D. Dewell, consulting structural engineer. The retiring directors are William Adrian and Harold M. Engle, and the holdover members are Mark Falk and M. V. Pregnoff, all of whom are consulting structural engineers in the area. Moore's election to the presidency of the group automatically gives

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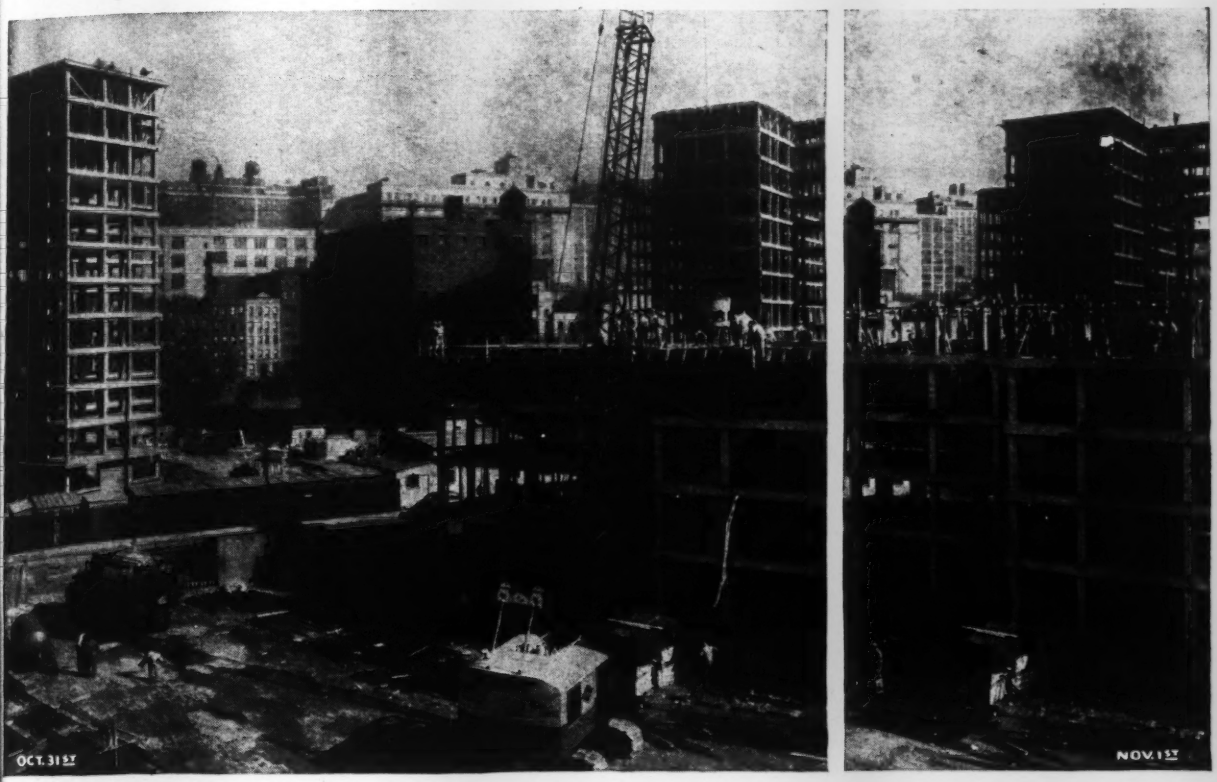

(Left) 11 AM, October 31st, pouring concrete floor; (right) same building 24 hours later—floor forms stripped, column forms being re-erected! John Lovejoy Elliott Houses, Chelsea District of New York City, for the New York City Housing Authority.
General Contractors—H. R. H. Construction Corp. **Sub-Contractors**—Knickerbocker Concrete Arch Construction Co., Inc. **Architects**—Brown & Lescaze

Only two of the four units of this vitally needed housing project could be started because of a shortage of key materials.

Knickerbocker, anxious to speed operations, agreed to place two sets of forms on each despite the increased cost and the difficulty of handling them. But when materials became available for the third and fourth units, they immediately decided to use Lehigh Early Strength Cement, thus enabling them to place concrete one day and strip the forms the next morning . . . with only one set of forms required for each of the four units. Result? A clear saving of three days per floor throughout the balance of the job! Smoother operations and other worthwhile savings accrued too, as the schedule gathered momentum.

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Provides accurate spread—from a trickle to a heavy flow ✓

Large spreader box has simple adjustments for all widths ✓

Saves up to 51% in labor and up to 20% in material ✓

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him the same office for the statewide Structural Engineers Association. The northern and southern sections hold a joint meeting once a year.

C. Y. Thomason of Greenwood, S. C., has been elected president of the Carolinas Branch, Associated General Contractors of America, to succeed Edwin L. Jones of Charlotte, N. C. Robert H. Pinnix of Gastonia, N. C., was elected vice-president and C. P. Street of Charlotte, N. C., treasurer.

Harvey Holcomb, Elyria, Ohio, has been elected president of the Lake Erie chapter, Ohio Society of Professional Engineers, succeeding C. A. Thrasher, Sandusky.

The Wisconsin Road Builders' Association will hold its 1947 annual meeting in Milwaukee, Wisconsin, March 4-5, 1947.

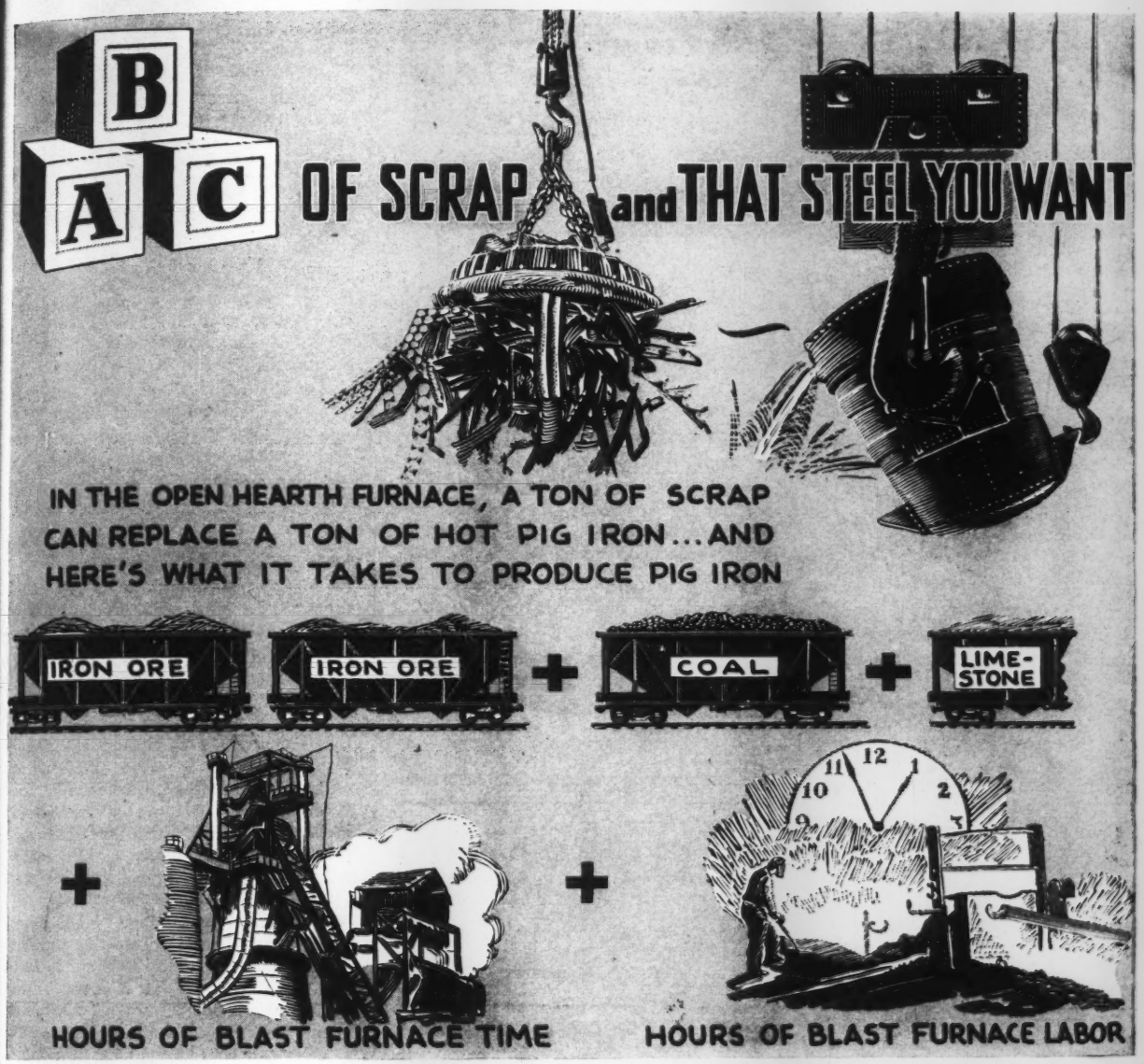
A chapter of the National Association of Home Builders of the U. S. A. has been organized in Wilmington, Del. with these officers: A. J. Vilone, president; A. L. McCabe, vice-president; Francis E. B. McCann, secretary, and Frank Collins, member of the national board. On the executive committee are: Joseph Johnson, chairman; Bernard McGovern and A. Fortunato.

The Wisconsin Section of the American Water Works Association has elected J. J. McCarthy of Racine, chairman, Verne Somers of Stevens Point, vice-chairman, J. A. Snow of Ashland, director and L. A. Smith of Madison was elected secretary-treasurer.

The newly formed Kewanee chapter of the Illinois Society of Professional Engineers has elected John H. Fulper president. Other officers receiving majority votes are: vice-president, Nick Fischer; secretary-treasurer, A. D. Spicer. Allen R. Boudinot is chapter representative.

L. B. Taylor has been elected president of the Professional Engineers Association of Southeast Florida. Other officers are: R. A. Williams, Miami, first vice-president; J. O. Bendla, Ft. Lauderdale, second vice-president; S. L. Stewart, Hollywood, third vice-president; B. C. Morene, Key West; fourth vice-president; C. J. Senerchia, Miami, secretary-treasurer.

William H. Vance, chief engineer, Missouri-Pacific Railroad, was awarded a life membership in the American Society of Engineers, Dec. 10. The honor was bestowed upon him for outstanding



To you "scrap" may be just worn-out machinery, broken pipe and such junk---worth nothing to your business.

But it IS worth a lot to your business delivered to the steel producer. Scrap may be the means of supplying you with more of the new steel and steel products you want.

As every buyer knows, steel is produced by "blending" hot pig iron and scrap in the open hearth furnace. Each ton of available scrap can replace a ton of pig iron. The greater the shortage of scrap, the heavier the drain on pig iron supply to produce a given tonnage of steel.

But every extra ton of pig iron produced calls for the use of approximately two extra tons of iron ore, one extra ton of coal and one extra half-ton of limestone, processed in a blast furnace, involving many extra hours of time and labor. It is obvious that there is a limit to America's blast furnace capacity. So the quickest, most effective way to produce maximum steel tonnage now is to find and use more scrap.

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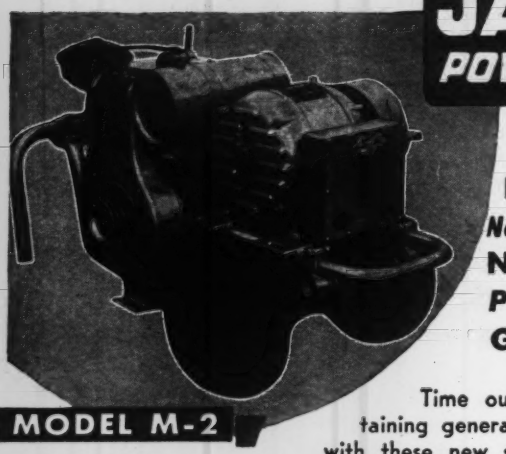

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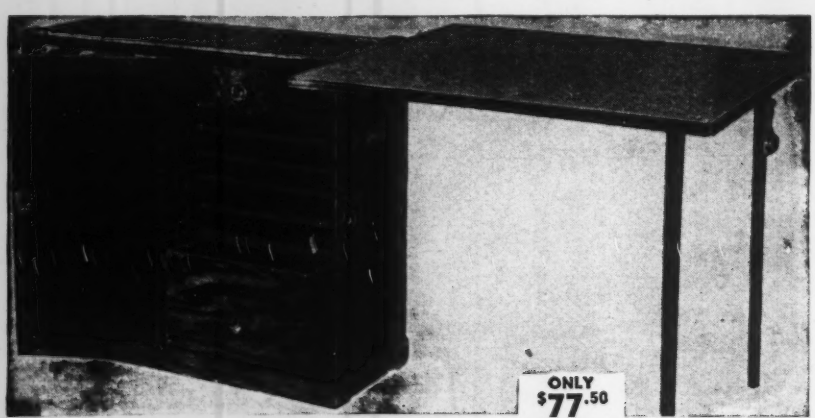

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engineering achievements. After graduation from the University of Illinois in engineering, he entered the firm of Sheppard, Morgan & Schwaab. Later he was with the Big Four, the Louisiana and Arkansas, and the Cotton Belt, and finally the Missouri Pacific.

The Illinois Society of Professional Engineers will hold its 62nd annual meeting in the Abraham Lincoln Hotel, Springfield, Ill., Jan. 24-25. Keith Legare will be the principal speaker at the luncheon and President H. T. Heald of Illinois Tech. will speak at the banquet.

Steve Kovach, Jr., will head the Home Builders Association of Allegheny County, Pa., in 1947. Other officers are: William Tussey, first vice-president; Frank Corace, second vice-president; Edward Hagel, secretary, and Ralph Scherger, treasurer. The six builder directors are Bill Dixon, A. N. Young, Felix Caste, Gust Larson, C. W. Eisner and Theodore Karr. Associate directors are Nevin Poole, Leroy Walker, Jack Gens, John Grossman and James Ferry.

Elected at the eleventh annual Illinois Sewage Treatment Works Operators' conference, at Springfield, were: chairman, Clifford Fore, superintendent of water and sewage, Carbondale; vice chairman, L. W. Hunt, superintendent, sewage disposal plant, Galesburg; secretary, Davis Miller, sanitary engineer, Great Lakes Naval Training Station.

The following trophies were given, to be awarded annually starting with the 1947 conference: The Bloomington-Normal, given by Harry E. Wilson, for the best maintained sewage treatment plant; the Elgin, given by Everett F. Smith, for the best plant operation; the DeKalb, given by Fred Simms, for the best operating reports. On the awards committee will be: Donald E. Henn, manager, DeKalb Sanitary District; F. E. Johnson, superintendent, Elgin Sanitary District; and George Hall, superintendent, Bloomington-Normal Sanitary District.

A contract is not just a piece of paper, but is the power or right to enforce a promise in a court of law as expressed by the apparent intention of language of the agreement, according to Oren C. Herwitz who spoke before 300 members of the Metropolitan Section of ASCE in New York Dec. 18. Mr. Herwitz—a practicing lawyer in New York and formerly deputy commissioner and special counsel to the Department of Public Works, City of New York—explained some of the finer points of law covered by ASCE Manual No. 8. At a business meeting of officers,

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directors and committee chairman of the Section, preceding the general meeting Col. William N. Carey, Executive Secretary ASCE explained the functions of the Engineers Joint Council.

Ralph C. Pybus, manager, Commonwealth Construction Co. Ltd., has been elected president of the Vancouver General Contractors' Association for 1946-47. He succeeds H. H. Johnson of Smith Bros. & Wilson, Ltd. Other officers include: First vice-president, F. J. Dawson, Dawson, Wade & Co., Ltd., second vice-president, L. G. Murray, B. C. Bridge & Dredging Co. Ltd.; directors, J. G. Bennet, Bennett & White Construction Co. Ltd.; A. J. Armstrong, Armstrong & Monteith Construction Co. Ltd.; W. D. Lee, Vancouver Pile Driving & Contracting Co. Ltd.; D. McAlister, General Construction Co. Ltd., J. Tucker, Dominion Construction Co. Ltd.

Officers elected for the Central Illinois Section of the American Society of Civil Engineers are: President, L. E. Philbrook, assistant engineer, bridge department, Illinois Division of Highways, Springfield; first vice-president, Prof. W. M. Lansford, theoretical and applied mechanics department, University of Illinois, Urbana-Champaign; second vice-president, N. H. Gundrum, engineer, in charge of construction and maintenance, Illinois Division of Highways, Springfield; secretary, Prof. Ellis Danner, civil engineer department, University of Illinois, Urbana-Champaign.

The Junior Forum of the San Francisco Section of the American Society of Civil Engineers elected the following officers: L. L. Wise, advisory committee member, and R. R. Murdoch, secretary. Other members of the advisory committee are Milos Polivka, retiring secretary, and Allen J. Chinn. As the group has a new chairman for each of its bimonthly meetings, the advisory committee assures continuity and acts as the policy-making body for the forum.

R. Preston Carter, head of architectural sales in the Cleveland area for the Aluminum Co. of America, has been elected president of the Cleveland chapter of the Producers Council, succeeding Howard Wentz, of the Armstrong Cork Co. Also elected were: Harold Bergman, of J. A. Zurn Mfg. Co. and Coyne & Delany Co., vice-president; Carl Schumann, of Mueller Brass Co., treasurer; and Robert H. Lutzy, of Johns-Manville Co., secretary.

Officers elected during a recent meeting of the City and County Engineers Association of Los Angeles, Calif.,

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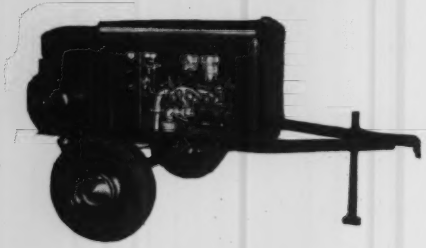

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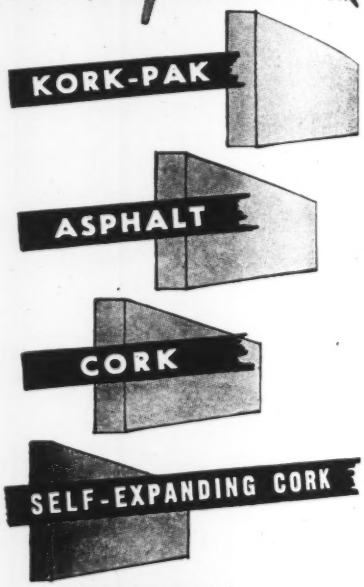

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Premolded ASPHALT Joint is a mixture of asphalt, fiber, and mineral filler preformed between felt strips. The standard joint for use where concrete slabs are not subject to excessive movement, and some extrusion is not objectionable.

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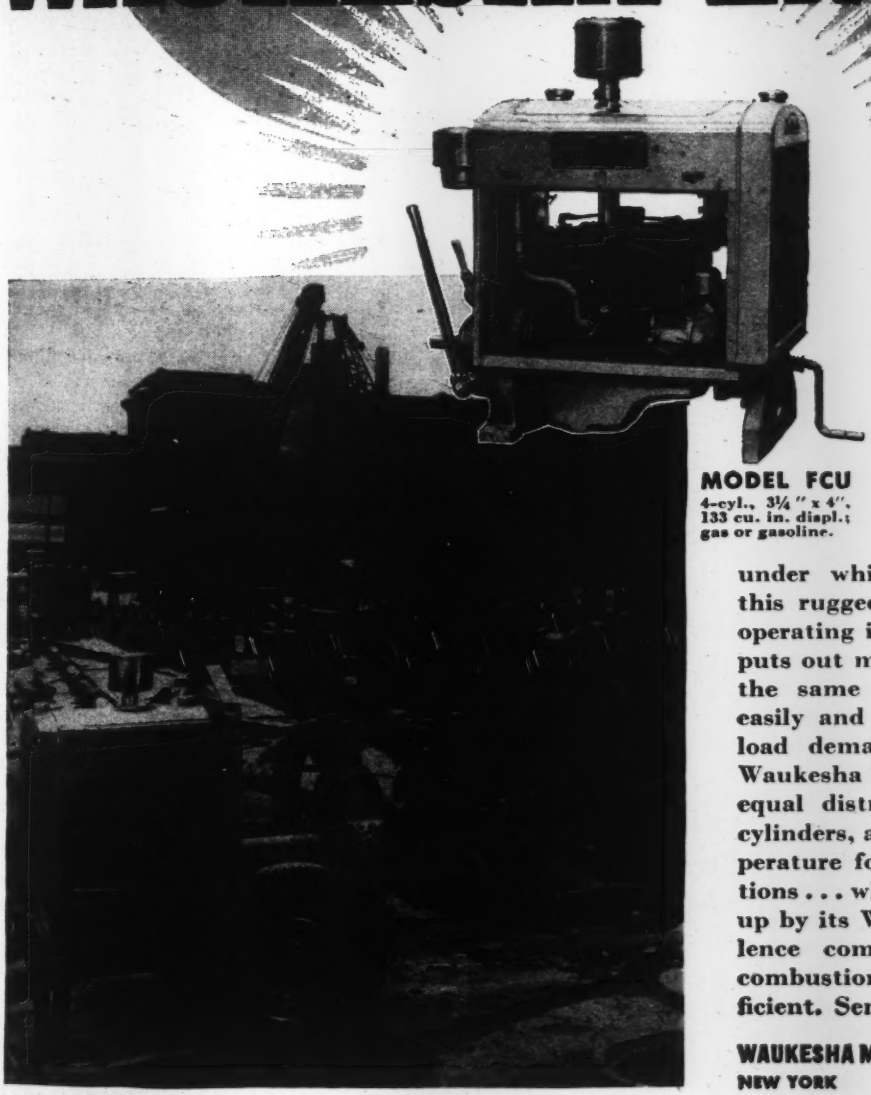

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4-cyl., 3¼ " x 4", 133 cu. in. displ.; gas or gasoline.

● This construction job on a busy city street made it necessary for the contractor to by-pass sewage. The men are observing with satisfaction how easily the Model 421 Marlow Pump with its Waukesha FCU Power Unit is taking care of it.

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The B-G Paving Bucket Loader and Portable Mixer team up to form this high-capacity, portable unit. Its accuracy in proportioning, measuring and mixing means a far better road-mix than is possible with ordinary "on-the-road" units.

The second important advantage is the fact that with this B-G Travel Plant, you can cut your yardage costs through the use of low-cost local materials.

There are many other Barber-Greene constant-flow units for mixing and placing bituminous mix—and for cement and soil stabilization. Like this Barber-Greene Travel Plant they might well help you bid for, and get, more profitable jobs. Write for the Barber-Greene Catalog No. 848 which describes and illustrates B-G asphalt equipment. Barber-Greene Company, Aurora, Illinois.

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were: W. M. Jarrett, Alhambra city engineer, president; Ezra B. Ryder, senior engineer of the Metropolitan Water District, vice-president; and H. W. Symmonds, engineer in the county surveyor's office, secretary-treasurer. Membership in the group, limited to Los Angeles County, totals about 175.

Charles Sprinkle has been elected president of the Winston-Salem, N. C., Engineers Club, succeeding Mason Garber. Other officers elected are: C. F. Vance, vice-president; H. F. Day, secretary; W. C. Lamb, treasurer; B. S. Mauney and Mason Garber, directors for one year; and W. W. Cantrell and W. E. Gaines, directors for two years.

W. H. Emory Jr. of Klug & Smith Co. has been elected president of the Building Trades Employers' Association of Milwaukee, Wis.; John H. Dahlman of Dahlman Construction Co., was elected first vice-president; W. T. Dortch of Pittsburg Plate Glass Co., second vice-president; Henry Jaeger of Jaeger Sand & Gravel Co., treasurer; and Erwin Endlich of Endlich Construction Co., Secretary. S. H. Eigle is manager of the association.

L. H. Howson of Alvord, Burdick and Howson, consulting engineers, Chicago, was elected president of the Illinois Section of the American Society of Civil engineers at its annual meeting held in Chicago on Dec. 11. C. H. Mottier, chief engineer of the Illinois Central Railroad Co. was named vice president and C. R. Ege, assistant manager of the Portland Cement Association, Chicago, was re-elected treasurer.

At this meeting life memberships in the society were presented to Julius R. Hall, Andrew H. McDougall and George A. Quinlan.

The Georgia chapter of the National Society of Professional Engineers has elected Cherry L. Emerson, Dean of Engineering of Georgia Tech, president, succeeding Carl W. Evans. Other officers; Roy S. King, of Atlanta, first vice-president; Russell P. Pool, of Rome, second vice-president; Dr. R. L. Sweigert, of Atlanta, secretary; and Arley Walker, of Atlanta, was elected treasurer.

Armstrong Chinn, Chicago, chief operations engineer of the Alton Railroad, has been elected president of the Terminal Railroad Association, St. Louis, Mo., succeeding the late Philip J. Wason, Mr. Chinn was graduated from Virginia Polytechnic Institute, in 1915, with a later civil engineering degree from that college.

During a recent meeting, the Planning Congress of Los Angeles County, Calif., elected the following officers: J. L. Schimmer, Jr., Santa Monica city commissioner, president; Charles B. Bennett, Los Angeles planning director, John C. Gilbert, Burbank city commissioner and Dr. W. L. Bigham, chairman of the Orange County planning Commission, vice-president. J. A. Mellen, regional planning commissioner, was elected secretary-treasurer.

H. D. Thomasson, an engineer with the Missouri state highway department at Springfield, Mo., was elected president of the Ozarks chapter of the Missouri Society of Professional Engineers, at a meeting held in Springfield recently.

Col. A. V. Shelton of the Corps of Engineers has been elected president of the Atlanta Post of the Society of American Military Engineers, to succeed S. R. Young, chief engineer and assistant general manager of the Atlanta and West Point Railroad. Other officers include: Col. Mose E. Cox, chief engineer of the Georgia State Highway Department, vice-president; L. G. Leach, U. S. Engineers, secretary; Irving Bearse, U. S. Engineers, assistant Secretary, and George Normandy, of Georgia Power Company, treasurer. Directors elected included: Col. A. J. Bain, C. W. Horton, James A. Higgs, Col. Thomas H. Evans, C. P. Lindnerand and George H. Bond.

J. L. Ewell of Lakeland has been re-elected president of the Florida West Coast Chapter of the Associated General Contractors of America.

Charles E. McKee, Columbus, Ohio, chief engineer of the Ohio Highway Department bureau of location and design, has been appointed secretary of the Ohio Contractor's Assn.

Officers elected by the Capital Chapter of the Illinois Society of Professional Engineers, Springfield, are: president, S. J. Sibley, partner and chief engineer, Ash and Sibley; vice-president, R. S. Nelle, principal sanitary engineer, Illinois Division of Sanitary Engineering; and secretary-treasurer, A. M. Frost, superintendent of the Electric department, City Water, Light and Power Department.

W. T. Bookout, Las Vegas, N. M., has been chosen president of the Associated Contractors of New Mexico. Selection was by directors of the organization at a meeting in Las Vegas. Other new officers named by the directors: J. H. Ryan, vice-president, and G. I. Martin, secretary-treasurer, both

Only the NEW TYPE "R" MORRIS SLURRY PUMP has these 4 FEATURES!

1. The gland is under suction pressure only. This feature practically eliminates packing troubles.

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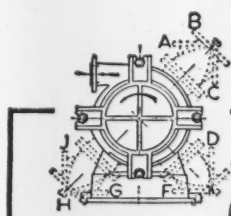

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The New Type "R" Morris Pump—the most advanced design in the pump field—is specifically engineered to handle sludges and silt; the moving of all types of caustic or acid mixtures containing abrasives or solids; and mixtures containing ore concentrates, tailings, slag, and the residue from filters and classifiers.

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of Albuquerque. Bookout succeeds Henry Thygesen, Albuquerque.

The Colorado Society of Engineers will hold its 31st annual convention at the Shirley-Savoy Hotel in Denver.

The Oklahoma state chapter of the Associated General Contractors of America, at a meeting held in Tulsa, Dec. 12, elected new officers for the ensuing year—E. H. Walpole, head of Dunning-Walpole Construction Co., of Oklahoma City, president; W. R. Grimshaw, of the W. R. Grimshaw Construction Co., of Tulsa, first vice-president; R. E. Mattison, of the R. E. Mattison Construction Co., Oklahoma City, second vice-president; Walter A. Nashert, W. A. Nashert Construction Co., of Oklahoma City, treasurer; and H. R. Jensen, Builders' Construction Co., Oklahoma City, member-secretary.

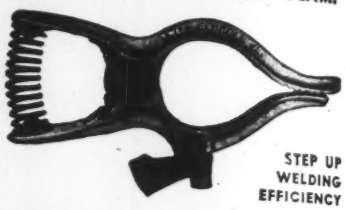
The Kansas City Chapter of Associated General Contractors at a meeting held Dec. 18, elected new officers of 1947. They are: Milton B. Schweiger, of the Schweiger Construction Co., president; H. H. Fox of the H. H. Fox Construction Co., vice-president; and Gus. F. Rau, Jr., of the Rau Construction Co., re-elected treasurer. Harry G. Palmer is executive secretary of the organization and the officers likewise serve as directors. The new officers will be installed at the annual dinner meeting of the chapter at the Hotel President, in Kansas City, Mo., Jan. 11.

William P. Hughes has been elected president of the Spokane section of the American Society of Civil Engineers. Other officers are Howard J. McCoy, first vice-president; A. S. Janssen, second vice-president, and W. A. Hill, secretary-treasurer.

Maurice Ahlquist of WallaWalla is the new president of the Washington State Reclamation Association, with John Scott of Sequim first vice-president and Walter Row of Maches second vice-president. Elected to the board of directors were Lars Langloe of Olympia, Jake Weber of Quincy, Percy R. Driggs of Moses Lake, Mac C. Taylor of Seattle. Iver Youngquist of Mount Vernon, Jesse Widby of Wenatchee, Dale Thorp of Okanogan and George R. Thompson of Chehalis. Axel Strom, formerly executive secretary of the Department of Agriculture's wage board in the state, was named managing secretary to succeed Thomas B. Hill, who retired because of ill health.

The following officers have been elected at Dallas, Tex., for the Texas Chapter of the Associated General Contractors: J. G. Bartholomew of Dallas,

"REDHEAD JR." GROUND CLAMP



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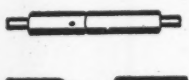

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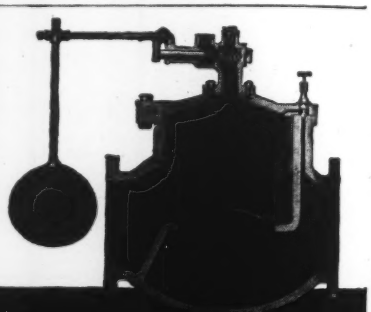

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president; E. W. Sherman of Oklahoma City, Okla., vice-president; and F. S. Oldt of Dallas, secretary and treasurer.

The chapter appointed a committee of two Dallas contractors to ascertain what could be done to fight the requirement of the Federal Works Agency that only union plumbers can work on jobs financed by federal money.

Dow Zabolio has become president of the Home Builders Association at Houston, Tex. Preston Plumb became vice-president; James C. Watts, executive vice-president; C. R. Brace, secretary; and Miles Strickland, treasurer. The following directors were elected: Frank W. Sharp, C. C. Bell, Jr., T. A. Robinson, T. F. Hackney, and W. G. Farrington.

The Alabama Section of the American Society of Civil Engineers has elected J. F. Tribble, a member of the State Highway Department as president. Other officers are Walter Shielke, Birmingham, and Philip Davis, Mobile, vice-presidents; A. N. Beck, Montgomery, secretary. Directors chosen were: T. F. Hobart, Birmingham; S. J. Cumming, Tuscaloosa; J. H. Mayer, Birmingham; D. H. Barber, Montgomery and Harry Myers, Mobile.

Delaware Alpha Chapter, Tau Beta Pi, national honorary engineering fraternity, has initiated these new members: Dr. Crawford H. Greenwalt, vice-president of the DuPont Co.; Frank H. Mackie, manager of the construction division of the DuPont Co.; Warren F. Beasley, technical assistant to the director of naval operations, Hercules Powder Co., and Ray Wheelock, assistant chief engineer, Hercules Powder Co., and the following students of the University of Delaware, H. S. Long, Herbert Rambe, James Kelley, Leland Insche and Augustus J. Shank.

C. E. Andrew, consulting engineer for the Washington State Toll Bridge Authority, has been elected president of the Tacoma section, American Society of Civil Engineers. Serving with him will be J. H. Stackhouse, vice-president; H. J. Whitacre Jr., secretary-treasurer, and N. E. Olaon, director.

Robert A. Duff of Medford, Ore., is chairman of a professional engineers' club recently organized by registered engineers in three Oregon counties—Josephine, Jackson and Curry. Other officers are C. V. Signor, Grants Pass City Manager, vice-chairman, and James K. Hoey, consulting engineer at Medford, secretary-treasurer.

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Yaun buckets are made to fit any job in capacities from 3/8 to 24 yards. Patented features of the Basket type-bucket, shown above, are duplicated in the Shell-type bucket except for the open construction of the rear.

We can make shipment in five days on any bucket up to and including four yards. For full information ask your Yaun distributor or write Yaun Dragline Buckets & Mfg. Plant, Baton Rouge, La.

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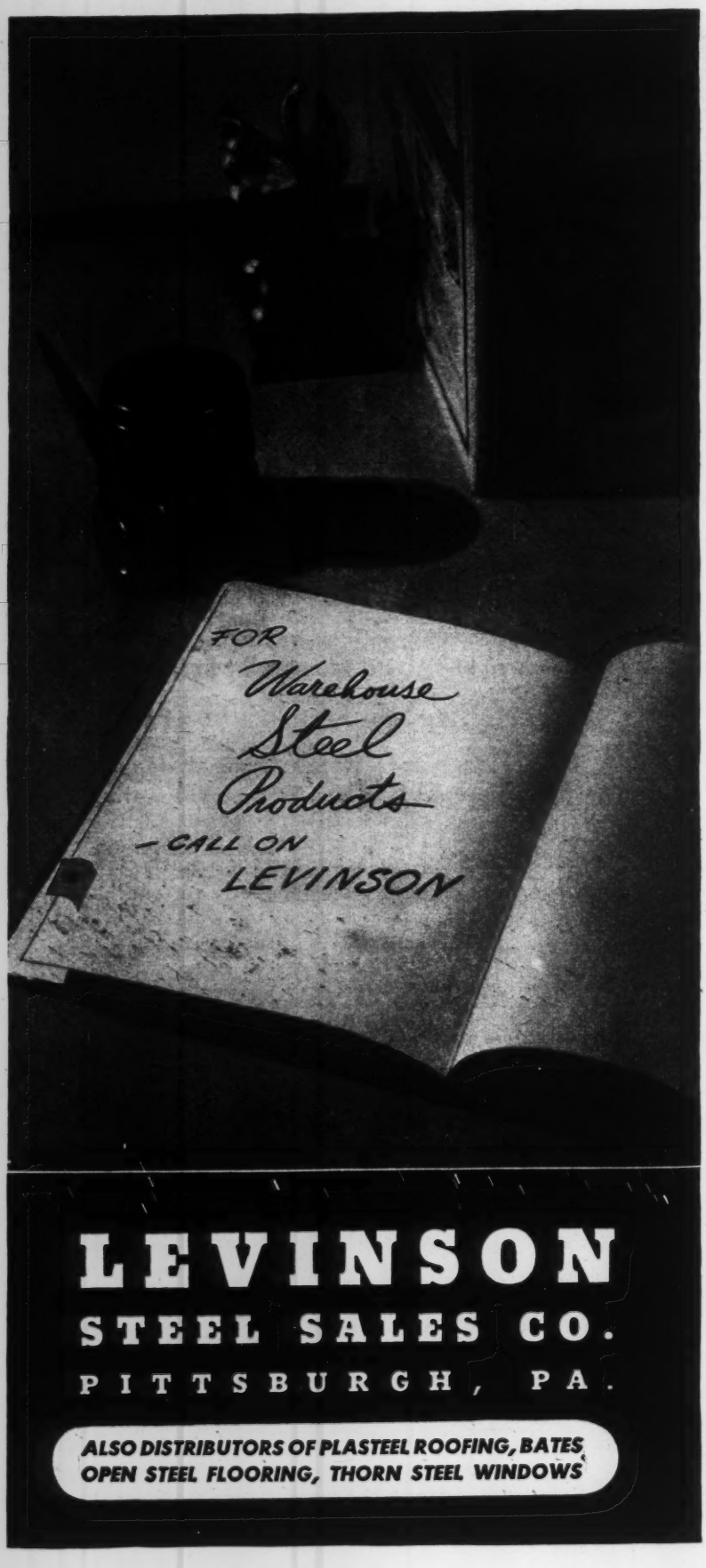
"MORE YARDAGE with a YAUN"



been chosen vice-president and general manager of the Greater Dallas Planning Council. Moore's appointment becomes effective Jan. 1 and he will open offices in downtown Dallas. The Greater Dallas Planning Council has a membership of 200. Its purpose is to serve in an advisory capacity to further the execution of the Dallas Master Plan. Matt Larkin, a county commissioner at Dallas and formerly an assistant county engineer, has been named county plan engineer at Dallas. Larkin, among other duties, will take over Moore's right-of-way agent's duties in his new position and co-ordinate county planning with laws that will soon be submitted to the Texas Legislature.

C. I. Hendricks has been elected president of the Ft. Worth Chapter, Texas Society Professional Engineers. He succeeds Joe. J. Rady. Other officers elected were: C. C. Zethraeus, vice-president; Frank Jackson, second vice-president; O. O. Elliott, secretary; A. B. Carson, treasurer; F. C. Clayton, W. A. Satterwhite and J. Matt Walker, directors.

Ex-Congressman Fritz G. Lanham has been named executive vice-president of the Trinity Improvement Association, Texas. He succeeds Roy Miller, pioneer in Trinity development who died recently. The expanded activity to promote improvement of the river and its watershed planned for next year was announced by Col. Henry Hutchings, Southwest Division, Army Engineers.

Newly-elected officers of the Los Angeles Section of ASCE who took office recently are as follows: President, C. R. Compton, assistant chief engineer, Los Angeles County Sanitation Districts; vice-president, R. L. Derby, assistant sanitary engineer, Los Angeles Department of Water & Power; vice-president, F. B. Laverty, chief hydraulic engineer, Los Angeles County Flood Control District; secretary, George Brandow, Brandow & Johnston, structural engineers; and treasurer, D. M. Wilson, professor of civil engineering, University of Southern California.

Newly-elected officers of the Lake County Chapter of the Illinois Society of Professional Engineers are: President, Chester L. Domke, superintendent of the Waukegan water filtration plant; vice-president, Elmer G. Pope, engineer, Meyer Construction Co., North Chicago; secretary-treasurer, Richard Thacker, Thacker Engineering Co. Chosen chapter representative for the state board of directors was Henry R. Bleck, former Waukegan city engineer, who is now property manager of the L. B. Harris Co., Round Lake.

Many homes for veterans being built in Montreal

Wartime Housing Ltd., a government-sponsored housing agency, will be authorized to build a further 1,500 houses for veterans in the Montreal, Que., district, according to a recent announcement. The increase, it was explained, is designed to cope with the needs of veterans in other municipalities besides Montreal proper.

The federal government had already approved 800 more houses for the city and J. O. Asselin, chairman of the city's executive committee, had expressed his willingness to go ahead with that number in 200 lots at a time, but, he suggested, the city had already supplied lots and services for 928 and had recently authorized a further 200 while neighboring municipalities had done little or nothing to provide low rental housing for veterans within their boundaries.

Coal processing plant standardizes product

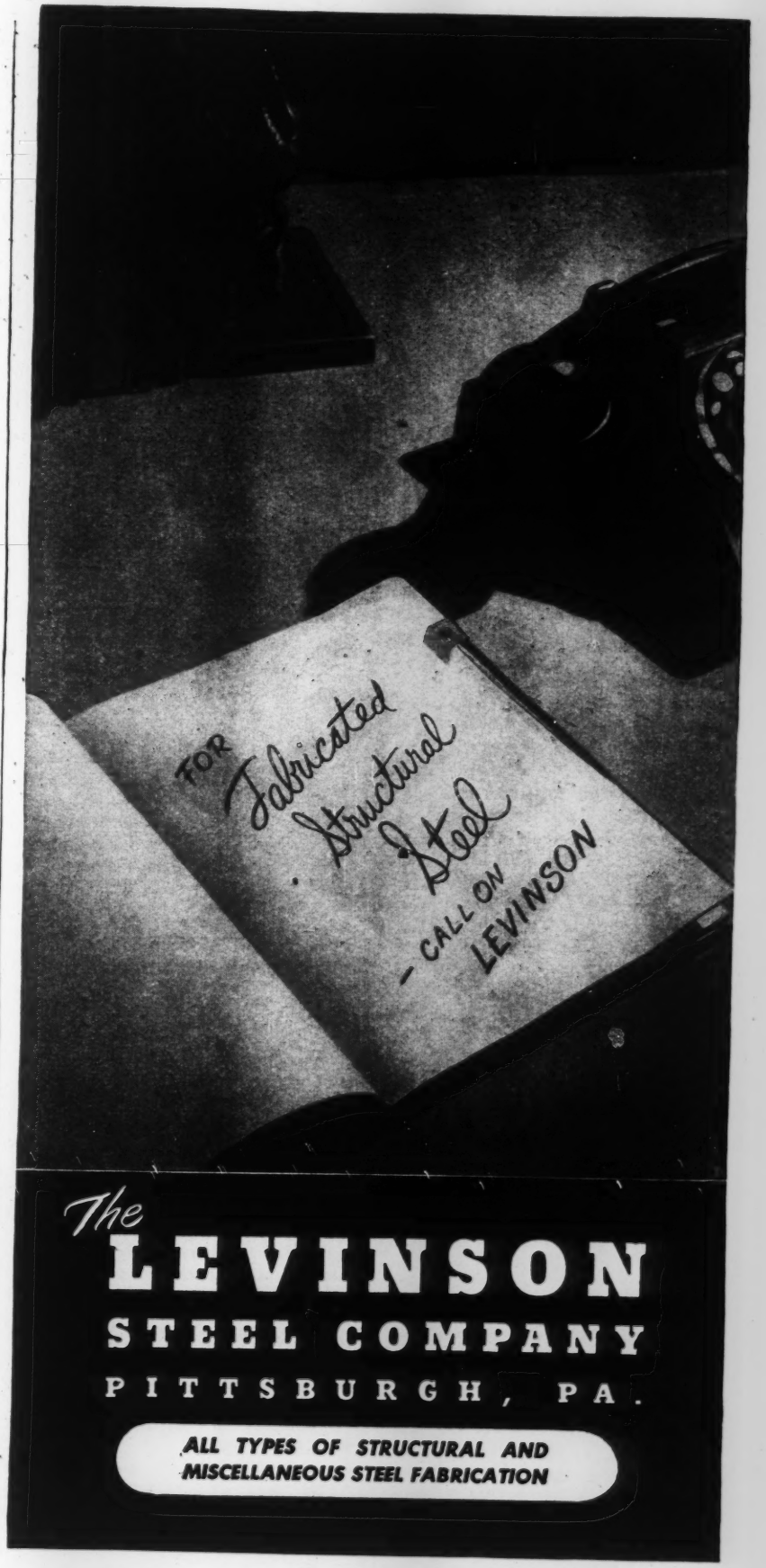
Construction of a $1,000,000 coal washing and processing plant has just been completed by the Blackfoot Coal and Land Corp. at Kerwin, Ind.

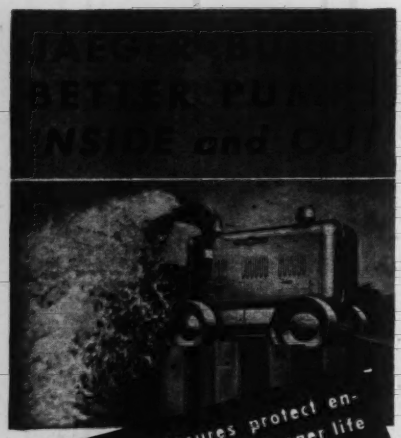
The plant, which has been under construction for a year, is about the size of an 8-story building and is capable of washing and processing 500 tons an hour. Its completion gives the company, which operates extensive strip mine properties in Pike County, what is said to be the most modern equipment of that kind in the state, making possible the standardization of the quality as well as the size of the coal.

PRA approval granted on 18 Ohio road projects

The Public Roads Administration has approved 18 Ohio federal-aid primary highway projects with an estimated cost of $9,283,748, it has been announced by State Highway Director Perry T. Ford. The PRA will furnish $4,620,748 of the estimated cost when the Ohio Legislature provides matching money. That will leave $3,272,507 in federal money for Ohio for 1947 federal-aid road projects, but additional primary projects will be withheld until the state highway department determines whether they can be completed with the allotted funds, he said.

The approved program includes one state-wide highway planning survey and 18 construction projects. Of the federal funds, $202,350 will go for three railway-highway projects.





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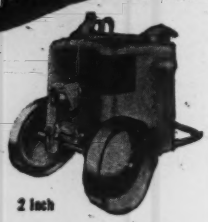

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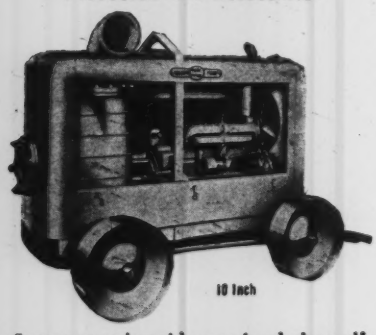

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N. H. corporation gets floating power plant

The USS Resistance, a floating power plant built for the U. S. Army and now moored at Hog Island, Philadelphia, Pa., has been sold to the Public Service Corporation of New Hampshire which bid $2,575,000 for the vessel, the highest of ten bids made.

War Assets Administration officials said the New Hampshire firm will get the boat for $950,000 in cash under an agreement which stipulates it will call off a suit it has pending against the Government. WAA spokesmen said the Army took over a power plant vessel from the firm at the start of the war and has never returned it. The government will keep the old vessel under terms of the new contract, turning the Resistance over to the company.

The Resistance, which was built in 1943, has been at Hog Island since last November.

California corporation fined for CPA violation

The Sainte Claire Corp., San Jose, Calif., co-owner of Lake Tahoe's Sky Harbor, has been fined $6,000 by the Reno, Nev., federal court for "willful violation" of CPA building priority regulations.

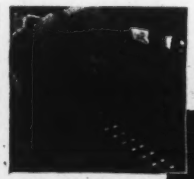
The penalty was assessed by Federal Judge Roger Foley for the completion of the Lake Tahoe resort's casino and other buildings in spite of a stop-construction order issued May 21.

Government housing units sold to private bidders

In the first sale of its kind in the Pacific Northwest under the disposal program of the Federal Housing Authority, a 300-unit housing project at Poulsbo, Wash., has been purchased by three Seattle men for $357,506. The successful bidders are George Matheny of the building materials firm of Matheny & Bacon; Charles M. Thomsen and Abe Sherman.

As Matheny's firm engages in the salvage of building materials, residents of the project at first feared he planned to wreck their homes. The new owners gave assurances, however, that they planned to operate the project as a rental affair and had no intention of wrecking it. Under terms of the sale, the tenancy of present occupants is protected until Dec. 31, 1947, and the rent schedule must remain the same.

The project, still almost completely occupied, was built to house workers at a nearby naval installation.



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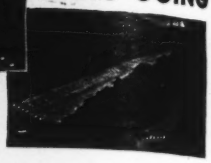

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Bricks for 15,000 homes available in Los Angeles

Enough new bricks for 15,000 homes will be available in the Los Angeles area between now and spring, it was forecast by H. C. Mathers, president of the Associated Brick Mfrs. of Southern California, during the joint conference of that group and the Mason Contractors Exchange of Southern California, held recently in Los Angeles. More brick machines are being installed in Los Angeles than ever before, Mathers said, and the 35 million new bricks to be produced there before spring will release substantial quantities of other building materials.

During the same conference, Frank J. Smith, president of the Mason Contractors Exchange, announced that wages for bricklayers, stone masons and bricktenders must remain at their present levels to avoid further raising of construction costs and consequent reduction in building. This policy will guide the contractors who will negotiate with AFL unions to iron out wages, rules and working conditions, during pending negotiations.

Connecticut road bureau cleared in damage suit

Superior Court Judge Kenneth Wynne rendered a decision Dec. 3 in favor of the Connecticut State Highway Department and Highway Commissioner William J. Cox in the $100,000 damage suit brought by John Arborio, Inc., Poughkeepsie, N. Y., road builder.

The suit was based on extra work done by Arborio and the extra materials required beyond contract specifications in constructing a part of the Wilbur Cross Highway in West Haven and Hamden. Judge Wynne ruled the highway department had not required anything beyond the terms of the contract.

Well steaming prevents frozen water mains

Freezing of water mains during severe winter weather constituted a serious problem at Prescott, Ontario, until a method was evolved of raising the temperature of water pumped into the mains. While the solution adopted is simple, it has proven its value, since no further trouble has been experienced. Source of supply for the town is a well, to which gravity flow from the nearby St. Lawrence River finds its way through sand and gravel. This underground flow enters the well at the freezing point.

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1049	1.17	1.98	7.68	12.28	30.70¢
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C. I. P. CENTURY CLUB GAINS

Wilmington, Del. Newark, N.J. Boston, Mass.

This year, according to our records, the above named cities, having cast iron mains now in their 100th year of service, are eligible to join the growing group of municipalities already members of the Cast Iron Pipe Century Club. There are no dues, nor any obligation other than to inform us if the qualifying main is taken out of service, or, sold for re-use in another city. Incidentally, the membership outlook for C. I. P. C. C. is promising since many cities have some or all of their original cast iron mains in service, a number of them within hailing distance of the century mark.

Large cities do not keep inefficient mains in service, however old, for sentiment's sake. Cast iron water mains, laid a century or more ago, still function in America's largest cities because they offer additional years, generations, or even centuries, of efficient life. This is what we mean by *efficient* life:

> *"Cast iron pipe not only offers a century or more of efficient life as a structure—it offers a century or more of efficient life as a carrier. In the limited areas with tuberculating waters,*

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